UNITED STATES

DEPARTMENT OF COMMERCE

EDITION
AUGUST — 1936

The United States Department of Commerce

How it Serves You
On Land, and Sea, and in the Air

A Description of the Various Activities Carried on in Behalf of the American People by the Branches of this Service Department of the Federal Government

August 1936

This booklet tells how the Department of Commerce safeguards life, preserves property, and fosters, develops, and promotes the commerce and industry of this country

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ORGANIZATION OF THE DEPARTMENT

[August 1936]

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FOREWORD

When Gouverneur Morris in 1787, at the Constitutional Convention, "submitted a proposal that there should be . . . a Secretary of Commerce and Finance, whose duties were, in part, to recommend such things as may in his judgment promote the commercial interests of the United States," it is probable that he would have been extremely surprised had he been told that when his suggestion became a reality some 116 years later the duties of the office he recommended would extend from the supervision of a trained commercial observer in Johannesburg to the direction of a skilled constructor of precision instruments; from the control of a fleet of airplanes and ships to the coordination of the work of several scores of statisticians and economists; from the compilation of a census of religious bodies to the care and protection of a few hundred sealers in Alaska.

The regulative and promotive functions which have been assumed by the Department of Commerce since its establishment in 1903 are a far cry indeed from the ideas in the minds of the Department's spiritual grandfathers—a few delegates from Maryland and Virginia who gathered in 1785 at Mount Vernon by invitation of General Washington to adjust and promote commerce and trade between these two States. As that commerce and trade expanded, became more inclusive and complex, so the duties of the Department created to promote and preserve its welfare have become enlarged, more ramified, more important.

Now, in 1936, the Department of Commerce has become the service arm of the Administration for American business. Besides its regulatory powers, such as the maintenance of land and sea beacons, charting of coasts and harbors, licensing and registering of ships and planes and enforcing navigation laws, it also has the equally important functions of a promotive nature—aiding and stimulating industry and commerce by the million-and-one means which it has at its disposal.

An informal résumé of the scope of the Department of Commerce, suggesting only the broad outlines of its primary functions, is contained in the following pages. It is my hope that the wider its work is known, the more extensively its services may be utilized.

Daniel C. Roper,
Secretary of Commerce.

August 1936.

BUREAU OF AIR COMMERCE

EUGENE L. VIDAL, Director

Airline craft speeding from coast to coast in 16 hours; a pilot racing through the night with a sick child who must be taken to a famous surgeon; another pilot flying back and forth across a forest taking pictures for an aerial photographic map; a grease-covered mechanic overhauling an engine in a repair shop—all these and many other types of operations are aided and encouraged by the aeronautical program of the Department of Commerce.

The Bureau of Air Commerce of the Department of Commerce is the Federal agency which has responsibility for promotion and regulation of air commerce. Whether you are a passenger in a transcontinental airliner or the purchaser of a ticket for a sightseeing flight at your city's airport you can be assured that the Bureau of Air Commerce has satisfied itself as to the airworthiness of the aircraft, and the qualifications of the persons who fly the plane, direct its operations from the ground, service it, and make any repairs that become necessary. In flying cross-country, you will have at your command the lights, intermediate fields, radio facilities, and weather-reporting service of the Federal Airways System.

The last decade has seen an amazing development in civil aeronautics in the United States. Ten years ago the sight of an airplane was a novelty to most persons. Now, flying is an accepted transportation medium for passengers, mail, and express, and numerous individuals own airplanes which they use for sport and pleasure. Aerial surveying, crop dusting, emergency flights with ill or injured persons, special trips with news photographs and advertising missions are among the tasks of civil aeronautics.

Since the passage of the Air Commerce Act of 1926, the Department of Commerce has participated in this development of civilian flying. Under the mandate of that organic act, the Bureau of Air Commerce (until recently known as the Aeronautics Branch) of the Department establishes, operates and maintains airways; pursues research on aids to air navigation; licenses aircraft and airmen; regulates scheduled airlines; approves aircraft, engines, propellers, components, accessories, and parachutes as to airworthiness; inspects repairs to licensed aircraft; approves repair stations and flying schools; investigates aircraft accidents; and enforces the Air Commerce Regulations, including the Air Traffic Rules.

THE FEDERAL AIRWAYS SYSTEM

Every day and night the rotating beacon lights, intermediate landing fields, radio stations and weather-reporting facilities of the Federal Airways System

serve airmen flying on nearly 20,000 miles of routes. Airplanes availing themselves of this service include craft of airlines, miscellaneous operators, and private owners; air navigation aids established and maintained by the Air Navigation Division of the Bureau of Air Commerce are at the command of all who fly.

They are available to us if we wish to make a flight today—or, better still, let us make it a night flight, for then the lights will be burning and, in addition, the darkness will emphasize to us the dependability of the airway aids when it is difficult or impossible to see ordinary landmarks.

It is evening, then; the sun has just set. Our airplane will be ready for us in a few minutes, and in the meantime we will check on weather conditions. The operator in charge at the Department of Commerce communication station in the Administration Building gets reports every hour by teletypewriter from stations along the airway routes converging at this airport, and forecasts for the airway routes are furnished every four hours by the Weather Bureau.

This communication station also operates a radio broadcasting transmitter and a radio range beacon. Equipment of these radio transmitters is housed in a building several miles away, and operated by remote control because the high radio towers would be an obstruction to landing airplanes if they were nearby.

We shall have more to do with radio later. At present, we want to see the weather map which has just been received on a teletypewriter printer. Drawn up by the Weather Bureau and transmitted from a central point by the Department of Commerce, the map shows weather conditions at airports and other points, and shows where the areas of high and low barometric pressure lie. Movements of these high- and low-pressure areas, as indicated on successive maps during the day and night, give clues to the probable trend in the next few hours.

Good weather is indicated along the airway we plan to fly. Reports from the stations located along our route show unlimited or good ceilings and visibility, the map tells us that fair weather is the order of the day in this part of the country, and the official forecast for the airway section is "Ceilings good to unlimited, visibility unlimited." "Ceiling" refers to height of clouds, "visibility" to the distance which may be seen horizontally.

There is nothing to keep us further, and our plane is ready, so we will take off. Since this is an imaginary flight, we can sit in the cockpit with the pilot, a privilege that we might not have in actual practice.

We are in the air now, and as the people and buildings below shrink into miniature, we look ahead for the first airway beacon. It shows up as a flash of light, appearing momentarily and then disappearing. Many other lights are flickering on as the darkness increases, but we are able to distinguish the beacon from the others by this flashing peculiarity.

It shows six flashes each minute, this characteristic being introduced by rotating the light. Each time it comes around so that the beam is directed toward us, we see a flash. There also are fixed projectors on the beacon tower. These are course lights, pointing in the direction of the airway, one ahead, one back. Most course lights are red, but those located at landing fields are green.

FORM 57 (Revised June, 1936) Approved .....

DEPARTMENT OF COMMERCE
Bureau of Foreign and Domestic Commerce
Washington

APPLICATION FOR LISTING IN EXPORTERS' INDEX

(The details requested in this Form are for the confidential information of the Bureau of Foreign and Domestic Commerce. This List is used only for the distribution of information.)

Fill out in duplicate and forward both copies to:

.....

.....

1. Name of firm.....
   (Print or type name in full; also give former name if changed recently)

2. Address.....

3. Export office located at.....

4. Name and title of export official in charge.....

5. Check in following list the nature of your business:
   Manufacturer, producer, or grower. Merchant.
   Manufacturer's agent, or combination export manager. Commission house.

6. Is your firm more than 50 percent American owned.....If not, give particulars:.....
   .....
   .....

7. Name the United States products you desire to export:
   This list should be given IN DETAIL, and should include only such goods as are produced, for export, in the United States.
   ....
   ....
   ....

READ CAREFULLY BEFORE SIGNING.

I agree that foreign trade information received from the Bureau of Foreign and Domestic Commerce will be used solely for promoting the sale abroad of goods produced, or further processed in the United States; that I will not circulate such information for profit nor permit it to fall into the hands of foreign competitors; and that such information as is marked "Confidential" will be carefully regarded as such.

(Signed).....

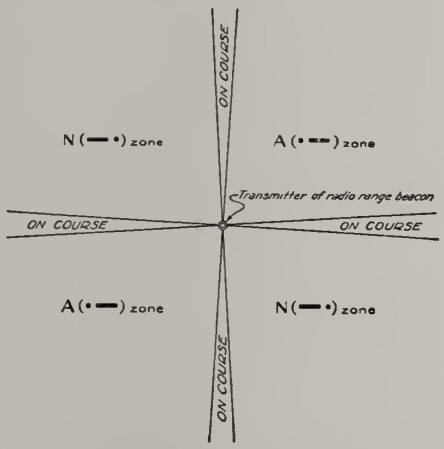
Date..... (Title).....

(If you are also an importer and desire your interest in importing recorded in the Bureau's Importers' Index, ask for Application Form 57a.)

This first light is 15 miles from the airport. We know that there should be another approximately 15 miles farther on, and looking carefully, we can distinguish the flash of the second beacon. Since we now can see two beacons, we fly in such a manner that we are in line with the two lights, and thus are sure that we are directly on the course.

If visibility were so poor that we could not depend upon the lights, we would not have cause for anxiety about losing our way because the airplane is equipped with radio. The pilot is tuning in now on the radio range beacon, and we will put on earphones so that we can hear it.

The range signal is coming in very clearly—a long-drawn-out hum. Suddenly it breaks off and we hear a code signal, given twice in rapid succession. Then the steady hum is resumed, to be interrupted presently by a repetition of the code signal, and this goes on as long as we keep our receiver tuned in or unless it is interrupted for voice communication. The hum is the "on-course" signal; the code tells us that we are listening to the range beacon near the airport from which we have just departed.



Courses Marked by a Radio Range Beacon.

Flying on course, the pilot hears a steady hum, broken off at intervals for a signal identifying the station. If he strays to one side of the course, he hears the letter A, on the other the letter N. When he is on course he hears both, but they interlock to form the steady hum which signifies "on course." After the airplane passes over the transmitter and proceeds along the opposite course the off-course signals are reversed. For example, if the pilot approaches the station on the lower course in the diagram, he would hear A on the left side, N on the right. After passing over the transmitter he would hear N on the left and A on the right.

The pilot is turning away from the airway now to show us what happens when an airplane strays from its true course. The steady hum is breaking up, and we hear "dot dash, dot dash, dot dash." Had we moved to the other side of the course, the signal would have been "dash dot, dash dot, dash dot."

We head back to the true course. Presently the range signals stop, and we hear a voice giving the call letters and city of the radio-communication station. The announcer continues with weather reports for points along the airway, giving ceiling height, visibility, wind direction and velocity, temperature, and barometric pressure for each one. At the end of the broadcast, which requires only a minute or two, the range signals are resumed.

Continuing on our way until we have proceeded about 50 miles along the route, we come to a beacon with green course lights. Near it we see a large oblong area marked out by clear white lights on the ground, and with green lights at each end. It is a Department of Commerce intermediate landing field, and the green lights are located at the ends of the runways. We could descend at the

field if there were any necessity for it. There is not, but we do talk to the airways keeper by radio. This is an important field, equipped with a radio marker beacon. This low-powered transmitter can broadcast radio range signals for about 25 miles (the big radio range is dependable up to about 100 miles) and also is used for two-way communication with airplanes. Another type of marker beacon emits a simple signal, received not more than 5 miles away, which gives the pilot a check on his position, and also engages in two-way radio communication.

The airways keeper gets teletypewriter reports on weather, so is able to assure us that conditions still are favorable. We proceed on our course, watching the beacons and listening to the radio, occasionally passing a cluster of lights that represents a town. At length a pronounced glow appears over a wide section of the horizon, which quickly resolves itself into the twinkling lights of a great city. It is our destination. We go on to the airport and land, and once more look for the Department of Commerce communication station where we shall learn of something else that is concerned with our trip.

Airways Rotating Beacon Light.

This is one of over 1,600 beacon lights which guide airmen over the Federal airways at night. It has a lens in each end of a 36-inch drum with a single incandescent lamp, projecting a high power beam which on clear nights is visible from 40 to 50 miles.

The operator runs through the sheets of communications that he has taken from his teletypewriter during the past two or three hours, and checks off several for us to read. Each one begins with PX (meaning position report) and consists of a few abbreviated words and figures. Our pilot understands these cryptic messages readily enough. Each one is a report of our progress along the airway. Before leaving, the pilot informed the Department of Commerce operator of our plans. As soon as we had taken off, a message to that effect went out on the teletypewriter circuit, and each time we passed over a station along the way the operator there reported it, so that our whereabouts was known to those on the ground during our entire journey. The airways keeper with whom we talked by radio sent one of the position reports.

Should we repeat this flight four or five years hence, many of the aids to air navigation would be different in their methods of operation. The radio range beacon, for example, might give directions by means of a dial and pointer on the instrument board instead of in our radio earphones. If necessary, we might land blind; that is, come down through fog without ever seeing the ground until the airplane's wheels touched the surface of the airport, guided by radio signals. These and other possible future developments are being studied by the Bureau of Air Commerce to the end that the aids to air navigation on the Federal Airways System will be the most dependable guides that it is practicable to supply.

The Air Navigation Division on June 1, 1934, was operating 17,315 miles of lighted airways, and an additional 1,755 miles of routes equipped for day operations. Beacon lights marking the routes numbered 1,630. There were 70 radio communication stations and 97 radio range beacons; and supplementary radio service, both communication and directional, over short distances, was given by 78 radio marker beacons. There were 257 intermediate landing fields. Weather data, maps, and other information were transmitted over 11,814 miles of teletypewriter circuits.

In addition to the airway program, the Air Navigation Division has responsibility for the aeronautic research of the Bureau of Air Commerce, which includes the researches on aids to air navigation previously mentioned.

The airway mapping program of the Bureau of Air Commerce is handled by the Division, the maps being compiled and printed for the Bureau by the Coast and Geodetic Survey. Sectional airway maps will chart the entire United States in accordance with a plan drawn up to meet the special needs of the airman for information as to location not only of cities and other geographical features, but also aids to air navigation such as airports, beacon lights, and radio stations. The series will include 87 maps, of which 26 had been issued on August 1, 1934.

REGULATION OF AIR COMMERCE

The applicant for an airman or aircraft license comes immediately into contact with the work of the Bureau of Air Commerce. Not so closely in touch with these functions, but nevertheless a direct beneficiary of them, is the person who rides as a passenger on an interstate airline. But regulation of air commerce has significance for still others, even for the person who has no opportunity to fly. The Air Traffic Rules, enforced by the Bureau, require among other things that airplanes remain at least 1,000 feet above towns and assemblages of persons, a requirement looking to the safety and comfort of both the man on the ground and the pilot.

Functions assigned to the Air Regulation Division include licensing of airmen (pilots, airplane and engine mechanics, and parachute riggers); approval of aircraft as types; licensing of individual aircraft; approval of engines, propellers, parachutes and accessories; regulation of scheduled air transport services;

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approval of flying schools and repair stations; investigation of accidents and enforcement of the Air Commerce Regulations.

General policies are formulated in Washington and carried out by a staff of inspectors covering the entire country. Aeronautical, engineering, airplane and school inspectors work from field headquarters offices at New York City, Los Angeles, Atlanta, Detroit, Chicago, Kansas City, Dallas, and Oakland.

An applicant for a pilot's license, if he never has held any Federal pilot license previously, reports first to a medical examiner of the Bureau of Air Commerce. There are about 700 examiners, all practicing physicians who have been designated to make these examinations for the Bureau. The applicant pays a fee to the physician for the examination. There is no other charge in connection with securing a license, and none which is paid to the Federal Government.

After examining the candidate, the medical examiner will certify him as qualified physically for a commercial grade of license, for a noncommercial grade, or reject him as unqualified, according to the circumstances. If qualified, the candidate will receive from the medical examiner a student permit authorizing him to proceed with flight instruction.

When he has completed 25 hours of solo flying the student may apply to an aeronautical inspector for an amateur license. He will be given a written examination and flight test, and, if successful in these tests, will receive his license. At the end of 50 hours the airman may proceed with the tests for the private license. "Amateur" and "private" are the noncommercial grades of pilot licenses.

At 50 hours the candidate may elect to apply for a limited commercial license, if his original medical examination qualified him for commercial grades. The written examination and flight test are more exacting than those for the private grade. A limited commercial pilot may carry passengers for hire, but is restricted in his commercial operations to the area immediately surrounding his home airport.

After 200 hours of solo flying the candidate is ready to apply for the transport grade. For this license he is required to demonstrate thorough knowledge of the Air Commerce Regulations, elementary engine and plane mechanics and plane rigging, and the fundamentals of meteorology and air navigation. Also, he has to pass a stringent flight test.

Airmen who have no desire to fly professionally frequently remain in the noncommercial grades, as renewal requirements, as well as original requisites, are less exacting. Commercial pilots renew their licenses each six months, and take a renewal physical examination each time. Noncommercial licenses are renewable annually, with physical examinations required every two years, and the renewal can be obtained by mail.

Having passed the examinations and received his license, the airman is responsible for observance of the regulations, and will have to answer to an inspector if he disregards them. In the event of an accident, the owner of the airplane is required to make a report to the Bureau of Air Commerce. Serious accidents

are thoroughly investigated, and the information so obtained guides the Bureau in preventing similar occurrences in the future.

No physical examination is required of mechanics and parachute riggers, but candidates for these licenses are required to give proof of experience as apprentices, and to demonstrate their ability. A mechanic may be licensed to work on airplanes, engines, or both. Also, one person may hold different kinds of licenses; for example, he may be a licensed pilot and a licensed mechanic.

For airplanes, the only requirement for approval and licensing is that they be airworthy. However, this involves extensive and detailed study of design, construction, and factory facilities. When a factory is preparing to introduce a new model, it applies for an "approved type certificate" (or approval without A.T.C. if only a limited number are to be produced). After this approval has been given, all airplanes built in accordance with the approved plans and specifications are eligible for Federal licenses. An airplane also can be licensed without prior type approval, but in this case it is subject to all the requirements and tests applying to the approved type certificate or approval without A.T.C. If major repairs are made or if it is rebuilt, the airplane is inspected before being relicensed.

Similarly, there are approved type certificates (and in some cases approvals without A.T.C.) for gliders, engines, propellers, parachutes, aircraft components, and accessories.

Flying schools and repair stations are approved only upon request. The rating issued by the Department of Commerce indicates that certain minimum requirements have been met, and is issued if the school or repair station wishes to have it and is able to meet the requirements.

Airline regulations, on the other hand, apply to all scheduled air-transport services which carry passengers interstate. The air-transport company is required to have a certificate of authority to operate, issued when it demonstrates that its equipment is airworthy and adequate, and that its personnel are competent and experienced.

Pilots in command of passenger air liners hold Scheduled Air Transport Ratings, for which the experience prerequisite is 1,200 hours of solo flying in the 8 years preceding date of application, including at least 500 hours of cross-country flying and 75 hours of night flying. The candidate has to demonstrate a high grade of proficiency in the use of radio and other aids to air navigation, and an understanding of weather analysis and forecasting. He is given a test in instrument and radio flying during which he puts an airplane through an extensive series of maneuvers while seated in a hooded cockpit. The latter test demonstrates that he is capable of operating through or over clouds, if that should become necessary.

All of the regulations are amended from time to time, as changing conditions in the aeronautics industry make revisions necessary. Those dealing with private flying were amended in December 1933—the changes including creation of the amateur grade of license, and introduction of the 2-year medical examination for noncommercial pilots in place of an annual medical examination.

All proposed changes are drafted with the cooperation of the section of the industry involved. Those dealing with private flying were discussed with pilots, flying-school officials, representatives of aeronautic organizations, and many others. Revisions in the airworthiness requirements for aircraft to become effective in 1934 were discussed at length with manufacturers, both individually and in conferences attended by representatives of the various companies. Regulations are administered and enforced by the Bureau of Air Commerce, but, in effect, the aeronautics industry regulates itself, for it recognizes the need for regulation, assists in drawing up the regulatory program, and observes these requirements when they have been promulgated.

ADMINISTRATION AND DISSEMINATION OF INFORMATION

Two sections of the Bureau of Air Commerce are not attached to either of the principal divisions, but are responsible to the Director of Air Commerce. The Administrative Section handles accounts, personnel records, purchases, disbursements, and other similar matters for the Washington office and the field headquarters of both the Air Navigation and Air Regulation Divisions. The Information Section is the clearing house for all information on civil aeronautics in the United States. It publishes bulletins on various phases of flying, furnishes material for magazines and newspapers, compiles statistics, answers requests for information about aeronautics or the work of the Bureau, and maintains records of airports and landing fields available throughout the country.

Encouraged in its development since about 1926 or 1927 by wide-spread interest and enthusiasm, the aeronautics industry is now rendering practical service to an ever-widening circle of travelers, air-mail users, air-express patrons, and private flyers. In many activities progress continued throughout the depression period, and a part of this development was made possible by Federal promotion and regulation.

BUREAU OF THE CENSUS

WILLIAM L. AUSTIN, Director

The Census Bureau is the child of the decennial census, and the latter derives its origin from that clause of the Constitution which provided that an enumeration of inhabitants should be made every 10 years to serve as the basis for the apportionment of Representatives in Congress. The 15 decennial censuses that have been taken since the Constitution was adopted measure the marvelous growth and development of the United States and reflect the world progress in invention, science, and discovery during 140 years of our history as a Nation. A comparison of the first census, as taken in 1790, with the fifteenth, as taken in 1930, brings out very strikingly the great contrast between conditions in early times and those of the present day.

THE FIRST DECENNIAL CENSUS: 1790

When the first census was taken the western boundary of the United States was the Mississippi River; and a portion of the southern boundary was formed by what is now the northern line of Florida. Western New York was a wilderness, and most of the territory west of the Alleghenies was unsettled and scarcely explored. Detroit was so small and isolated in that early day that it was not considered worth while to go to the trouble and expense of enumerating its inhabitants. New York City, which now boasts of being the largest city in the world, and was then as it has been ever since the largest in the United States, possessed only 33,000 inhabitants in 1790. Today there are 289 cities in the United States which have more population than New York then had.

Although the area covered by the first enumeration was much smaller than that for which the census statistics are now gathered, the physical difficulties of the undertaking were almost incomparably greater than those which confront the enumerators of the present day. Large sections of the country that had to be canvassed by the enumerator in 1790 were sparsely settled; and roads, where they existed at all, were poor and often impassable. Bridges were almost unknown. The saddle horse, the stage, and the private coach furnished the only means of land travel. A long day's journey was required to cover a distance now traveled in an hour. Mail service was irregular, expensive, and uncertain. The boundaries of towns and other subdivisions of counties, and often of the counties themselves, were in many cases undefined. Small wonder, then, that it took the census enumerators of 1790 18 months to visit and count the 3,929,214 people comprising the population of the United States at that time, although in 1930 the enumeration of 122,775,046 people was practically completed in 1 month.

Notwithstanding all the marvelous improvements in means of communication and travel, the differences between census taking now and in 1790 are not all to the advantage of the present-day enumerator. He encounters difficulties and vexations which gave little concern to his predecessor in 1790. Although it may take only a short time to convey him by automobile or electric or steam railway to the locality he is to canvass, and only a few seconds to shoot him from the ground to the twelfth floor of an apartment house, he is quite likely to find, when he gets there and presses the button, that the occupants are out. If it is the time of day when the breadwinners are not at their regular places of work and the housewife, if there is anyone who qualifies as such, is not shopping, and the children, if there are any, are not at school, then they are motoring or have gone to the ball game or the "movies" or the amusement park. So the disappointed enumerator must call again, and he may have to make repeated visits before he finds anyone at home to supply the information required for filling out the census schedule. The apartment-house population and more especially the shifting lodging-house population present problems of increasing difficulty in modern census taking; and the population in general is not as stable or as home-keeping as it was in the eighteenth century. Many changes of residence occur during the month that the census is in progress; and special precautions must be taken to make sure that the moving family is not missed altogether and is not enumerated more than once.

Troubles of this kind did not disturb the leisurely progress of census taking in 1790, when the enumerator jogged along on horseback over rough roads to canvass the rural districts, where more than 95 percent of the population then lived (the percentage is now about 44), or followed lonely forest trails to reach some remote frontier settlement, or, more fortunate, walked from house to house in the village or small city in which his district was located. It would be rare indeed that he did not find someone at home to answer his questions if not to welcome his arrival.

He could not, however, be quite sure of his welcome. Sectional jealousy and distrust of the new National Government existed in considerable degree. The census itself was a novel thing, and there was apprehension that it might be the prelude to an increase of taxation; and there were some who, familiar with Old Testament history, even believed that a numbering of the people was an act contrary to the divine will which might call down the wrath of Heaven upon the inhabitants of the land.

No elaborate tabulating machinery was needed for the census of 1790. The returns were slow in coming in, but the numbers were quickly and easily totaled; and the final results were published in an octavo volume of 56 pages, copies of which are very rare at the present time. There are only two in the possession of the Bureau of the Census, and there is one in the Library of Congress.

THE FIFTEENTH DECENNIAL CENSUS: 1930

The population census has vastly expanded since that first census in 1790 when the census taker merely recorded the name of the head of each family he visited and opposite the name entered the number merely (not the names) of free males in the family over 16 years of age, the number of free males under 16, the total number of free females, and the number of slaves, if any. The census taker now writes down the name of every member of the family; and the items of information recorded for each individual include relationship to the head of the family (as wife, son, daughter), sex, age, color or race, marital status (whether single, married, widowed, or divorced), whether attending school or college, nativity (state or country in which born), nativity of father, nativity of mother, and occupation, if any. Additional items of information are obtained for certain classes of the population, namely, for married persons, the date of first marriage; for persons over 10 years of age, whether able to read and write; for foreign-born persons, native language and whether naturalized; and for persons having an occupation, the name of the occupation and that of the industry in which engaged and whether unemployed. The value of the home, if owned, or the rent paid, if rented, was also reported by the census taker of 1930.

But the decennial census is by no means limited to a compilation of data about the population. Its scope has been gradually extended until it has come to be a comprehensive inventory of the population, resources, and economic activities of the Nation. The census of 1930 covered population, agriculture, irrigation, drainage, manufactures, mines, distribution or trade, construction or the building industry, and unemployment. It collected data regarding 122,775,046 persons comprised in the population of continental United States, 29,904,663 families, 6,288,648 farms, 210,059 manufacturing establishments, 1,543,158 retail stores, 169,702 wholesale establishments, and 30,597 establishments engaged in construction. The census also covered all outlying territories and possessions except the Philippine Islands.

The census inquiries addressed to the farmer include acreage of farm; value of land and buildings; mortgage debt; expenditures for labor, feed, and fertilizer; farm machinery and facilities; acreage, yield, and value of crops; quantity and value of livestock.

The manufacturer is asked to report the quantity and value of products; the number of salaried employees and of wage earners; aggregate payments for salaries and for wages; the cost of materials and fuel. Similar data are collected regarding mines and quarries.

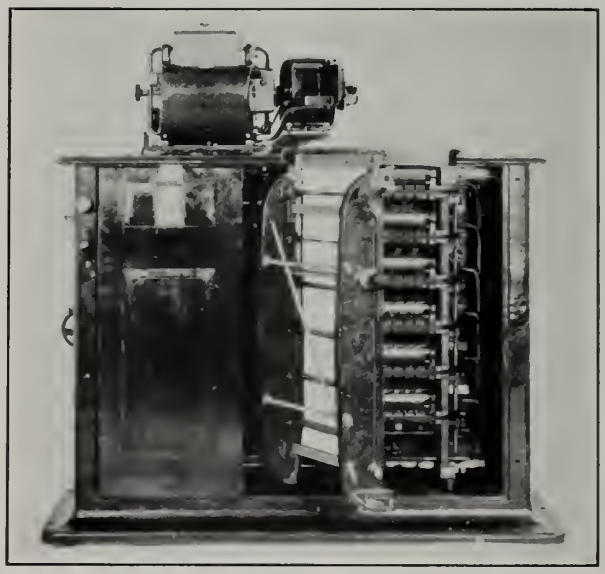
The items of information secured from the merchant in the census of distribution include kind of business; type of operation; net sales; number of employees; total amount paid in salaries and wages; stocks on hand.

In the census of construction the items of information secured from general contractors, subcontractors, and operative builders include value of construction; wage payments; cost of materials; subcontract work performed or let.

The census tabulated and published statistics in detail for each of 48 States, 3,073 counties, 93 cities of over 100,000, 3,072 cities or municipalities between 2,500 and 100,000, and 64,387 townships or other minor civil divisions; and it ascertained and reported the population of 13,433 incorporated places having less than 2,500 inhabitants. The printed reports giving the results of this, the most comprehensive census ever taken, comprise 32 volumes, containing a total of more than 30,000 printed pages, consisting mostly of statistical tables.

THE JOB OF TAKING A CENSUS

In preparation for a decennial census, the entire territory of the United States must be laid off and mapped out in more than 100,000 enumeration districts, each of the right size to be covered by a single enumerator. In the rural areas the districts may be defined by existing political boundaries, but this is not possible in cities, where a single block may be as much as one enumerator can take care of. At the census of 1930 the city of New York comprised 6,112 enumeration districts, each of which had to be accurately described and mapped to guard against any omission or overlapping of territory.



"Population" Automatic Tabulating Machine.

This machine automatically feeds the punched cards through an electrical registering device at the rate of about 400 a minute. In the picture here presented the "gate" or door of the machine stands part way open, showing the banks or rows of counters behind it. By closing the gate and pulling back the hand lever, the numbers registered on the counters are printed upon the the sheet of paper inserted at the back of the gate as shown in the picture. At the same time the counters are reset to zero ready for a continuation of the run of cards.

Schedules of inquiries must be formulated and printed well in advance of the date of the census. The population schedule provides for 100 names. Thus more than a million and a quarter of these schedules are needed for enumerating the population. In obtaining the required information about farms, one schedule is necessary for each farm; and there were 6,288,648 farms enumerated in the census of 1930. It is, of course, necessary to print many more schedules than will be actually filled out.

Preparatory to tabulating the census data the facts which the enumerator records on the census schedule regarding each individual inhabitant or farm

must be transferred to a punch card. That means about 125,000,000 cards for the population census. Fifteen or twenty punch cards are needed to carry the data for each farm; and in the aggregate more than 150,000,000 cards are required for the census of agriculture. To cover all the various divisions of the census of 1930 it was necessary to punch about 300,000,000 cards.

The punched cards are run through electrically operated sorting machines and electric tabulating machines. The tabulating machines for population have 60 counters, which means that it is possible to count 60 facts or combinations of facts at one run of the cards. The cards are run through the machine at the rate of about 400 a minute. The machines, of course, are not operated continuously. They have to be stopped at frequent intervals for readings as the runs for particular areas or political units are completed.

The electric tabulating machine provides the raw material for the next stage of work, which is the preparation of the statistical tables for printing in the final reports. This task requires the services of a large force of clerks working for many months without the aid of any machinery other than ordinary typewriters and adding or computing machines.

THE PERMANENT BUREAU

Since the Bureau of the Census, as already pointed out, traces its lineage back to the Constitution of the United States, it would seem to have a good claim to be considered the oldest bureau in the Department of Commerce. But that claim might be challenged by the Bureau of Lighthouses, on the ground that while lighthouses are not explicitly provided for in the Constitution, the law establishing the Lighthouse Service was passed August 7, 1789, while the law providing for the first decennial census was not enacted until March 1, 1790. The Census Bureau, moreover, has not had a continuous, uninterrupted existence. Prior to 1900 its life history resembled that of the phoenix. It was called into being every 10 years for the sole purpose of taking the decennial census of the United States. It expired as soon as that task was completed—to be recreated a few years later when time drew near for the next census. It was not until 1902 that it became a permanent Bureau; and since then its activities have by no means been confined to the taking of the decennial census, although that still remains its biggest single task. It takes, besides the decennial, many other censuses, and is continuously engaged in the compilation of statistics covering a wide range of subjects. It is, beyond a doubt, the largest statistical office in the world, having a normal annual output of not far from 5,000 pages of statistical tables and text, in addition to the voluminous reports of the decennial census.

The Bureau of the Census operates under a 10-year program, being in that respect unique among Government bureaus. Within the decade following the main decennial census it is required by law to take a census of defective, dependent, and delinquent classes; of financial statistics of State and local governments; of religious bodies; of agriculture; and of water transportation. A census of electrical industries is taken for the second and seventh years of the decade, and

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a census of manufactures is taken every second year. Statistics of births and deaths, and financial statistics of States and cities, are compiled annually. Then there are other classes of data which are compiled and published quarterly or monthly or at even briefer intervals.

The census of defective, dependent, and delinquent classes covers prisoners, patients in hospitals for the insane, juvenile delinquents in institutions, feeble-minded and epileptics in institutions, and children under institutional care. It includes a classification by sex, age, color or race, and nationality or country of birth. Prisoners are classified also by offense for which committed, and by nature or duration of sentence; and the insane are classified with reference to the psychoses, or the type of mental defect which resulted in their commitment to hospitals for the mentally diseased.

The Bureau annually collects statistics covering the financial transactions of State and city governments, showing revenues collected, taxes levied, municipal or State debt, interest payments, expenditures, and outlays. The statistics are presented in detail, so that by reference to the census reports one can ascertain, as regards any particular city or group of cities, how much public money was expended for general government, police departments, fire departments, sanitation, streets and other highways, education, recreation, and other miscellaneous purposes; and how much city revenue was derived from the general property tax, special property tax, business licenses, special assessments, or from other sources. He will find also detailed statements regarding the municipal debt, showing amount outstanding with a classification by rates of interest, by purpose for which incurred, etc.

The decennial compilation of statistics relating to "public indebtedness, valuation, taxation, and expenditures" is of the same general character as the annual compilations described in the preceding paragraph, but is more comprehensive, as it includes all cities of whatever size, as well as all States, counties, and minor civil divisions.

The quinquennial census of electrical industries covers central electric light and power stations, electric railways, telephones and telegraphs—giving number of companies, employees, capitalization, income, expenses, and other data.

The decennial census of religious bodies gives the number of churches and the church membership of each denomination, also the number and value of church edifices, the church expenditures, and some data regarding Sunday schools. It reveals the fact that there are in the United States 213 different religious sects or denominations. Many of these are small and not widely known. Forty-four of them have fewer than a thousand members each; and it is safe to say that the man on the street never even heard of the Christadelphians, or of the Schwenkfelders, or of the Apostolic Over-Coming Holy Church of God, or of the General Six-Principle Baptists, or of the Two-Seed-in-the-Spirit Predestinarian Baptists. Yet as revealed by the census, there are denominations or sects bearing these unfamiliar names and cherishing their own distinctive beliefs, tenets, or practices. The census report presents statistics for all sects or denominations, large

and small alike, and it includes carefully prepared statements covering their history, doctrines or creed, and organization.

The annual compilation of statistics of births and deaths made by the Bureau of the Census is based upon data obtained from the registration records of the individual States; and the act of 1902 which authorized the compilation of these statistics by the Bureau limited it to those States and municipalities which possessed birth or death records affording satisfactory data in necessary detail. At that time there were only 10 States which with the District of Columbia met this requirement with respect to the registration of deaths, and they constituted the death-registration area as originally established. The birth registration area was first established in 1915.

Both these areas have been extended from time to time as the States one after another enacted the necessary legislation and established satisfactory registration systems, until with the admission of Texas in 1933 they included the entire area of continental United States and also the Territory of Hawaii and the Virgin Islands. The death registration area includes Puerto Rico also. This means that the machinery has now been set up and put into operation for registering every death and every birth in the United States, and recording the disease, accident, or violence that caused the death, as well as the age, sex, nativity, conjugal condition, and occupation of the decedent; or in case of a birth the sex of the child, and the age, color, nativity, and occupation of the father and of the mother, the total number of children born to the mother, with other data, thereby furnishing the basis for the collection of complete vital statistics for the United States.

The Bureau of the Census is continuously engaged in the compilation of current statistics of the production of various commodities, including cotton, cottonseed, hosiery, underwear, boots and shoes, fabricated steel plate, various kinds of machinery, automobiles, floor and wall tile, paint and varnish, wheat flour, etc.—in all about 75 different commodities. The data in most cases are collected monthly and the returns are tabulated and published as promptly as possible, usually from 25 to 30 days after the end of the month.

COAST AND GEODETIC SURVEY

R. S. PATTON, Director

Every motorist who travels for any distance finds it convenient to use road maps and other data, that he may choose suitable routes, distances between overnight stops, accommodations en route, and available short cuts. The mariner, particularly in unfamiliar waters, finds charts and supplemental nautical publications more than convenient—they are indispensable. Approaching land, following sailing routes along a coast, or entering harbors, the navigator, unlike the motorist, cannot see the road ahead nor the underwater dangers to be avoided; in storm, fog, or darkness, there are no opportunities to ask the way. Unseen forces of the tide and ocean currents are acting continually to change the depth of the water under the keel of his ship, and to deflect him from his course.

The mariner is dependent in a large measure on adequate navigational information, not alone for the expeditious passage of his ship but for the safety of the lives and property under his charge. Striking evidence of this need is seen in the advantages, including decreases in shipwrecks and lower insurance rates, which invariably follow the completion of comprehensive coastal surveys and the publication of the resulting data.

Every maritime nation realizes the great practical value of a detailed knowledge of the nature and configuration of its coasts, the varying water depths, character of sea bottom, locations of reefs, shoals, and other dangers, the rise and fall of the tides, the directions and strength of currents, and the nature and amount of magnetic variation. All of these data, secured primarily for charts and related nautical publications, are becoming increasingly valuable because of their many collateral uses and their availability to everyone, as shown later in this section.

HISTORY OF BUREAU GROWTH

The Federal agency which carries on this work for the waters under the jurisdiction of the United States is the U.S. Coast and Geodetic Survey. Organized in 1807, during the administration of President Thomas Jefferson, as the "United States Coast Survey," this service began operations in 1816, and except for the periods 1818–1832 and 1834–1836 has carried on its functions without interruption.

This service may be likened to any large self-contained manufacturing organization, with a central office of administration in Washington, D.C. (and an office in Manila covering the Philippines), supervising the operations of various

charting activities on land and sea and utilizing the results, together with certain data from other sources, as basic materials for the preparation, printing, and distribution of the finished work.

The Atlantic coast from Maine to Georgia constituted the entire seaboard to be charted in the early days. With the addition of Florida, Texas, the Louisiana Purchase, the discovery of gold in California, the purchase of Alaska, and the addition of Puerto Rico, the Canal Zone, Guam, the Hawaiian and Philippine Islands, and the Virgin Islands of the United States, the demands upon the Bureau have grown with our national progress. Our seaboard now has a shoreline about 103,000 miles in length—more than four times the distance around the world.

From these coasts, surveys of water areas must be carried out to the edge of the continental shelf, in some places more than one hundred miles from land, for the configuration of the ocean floor is now as much an aid to the navigator equipped with modern depth-registering devices as are the outstanding landmarks he sees on approaching land. Furthermore, there are extensive sections along this vast seaboard which are subject to constant changes, from both natural causes and the works of man. Resurveys of such areas at suitable intervals are necessary to maintain the accuracy of our charts, and they constitute a never-ending task.

The remarkable growth of our country has been accompanied by a corresponding development in its commerce and navigation. Vessels plying our waters have changed from a few leisurely moving sailing ships, of some 15 feet in draft, to large and speedy liners and freighters with drafts up to 40 feet. This development has necessitated on several occasions complete changes in the type of charts required for navigation.

The added responsibilities of this Bureau, caused by the growth of our country and the constantly increasing requirements of navigation, have been met to some extent by moderate increases from time to time in its personnel and facilities and to a much larger degree by internal improvement through the consistent development of new methods and equipment, some revolutionary in character, enabling the Bureau with an attendant accuracy of results to increase greatly the possible output from a rather fixed appropriation.

GEODETIC SURVEYS

A consideration of the several major functions of the Bureau discloses the relationship which links these duties into a composite whole. One of the first requirements in the survey of any region is the establishment of geodetic control which is absolutely essential to the satisfactory execution of all extensive charting and mapping projects.

Geodetic operations, which take into account the curvature of the earth, include the determination of geographic positions (latitudes and longitudes) by triangulation or traverse, and the measurement of elevations by leveling. They also involve astronomical observations, the measurement of base lines, and the

determinations of gravity, to the extent necessary to provide essential data for the prosecution of field work and the office interpretation of results.

Having always carried on coastal control surveys, the Bureau in 1878 was assigned the continuation of such surveys into the interior, and its name was changed at that time to the "United States Coast and Geodetic Survey." It is because of this very practical control-survey job that a series of charts and maps covering the United States in its entirety may be put together like the many pieces of a picture puzzle.

Physical evidence of such work is the placing of many thousands of "station marks" distributed in series of belts about 25 miles apart throughout the 3,000,000 square miles of the United States. Any of these disturbed by any cause can be replaced with accuracy from the information kept on file.

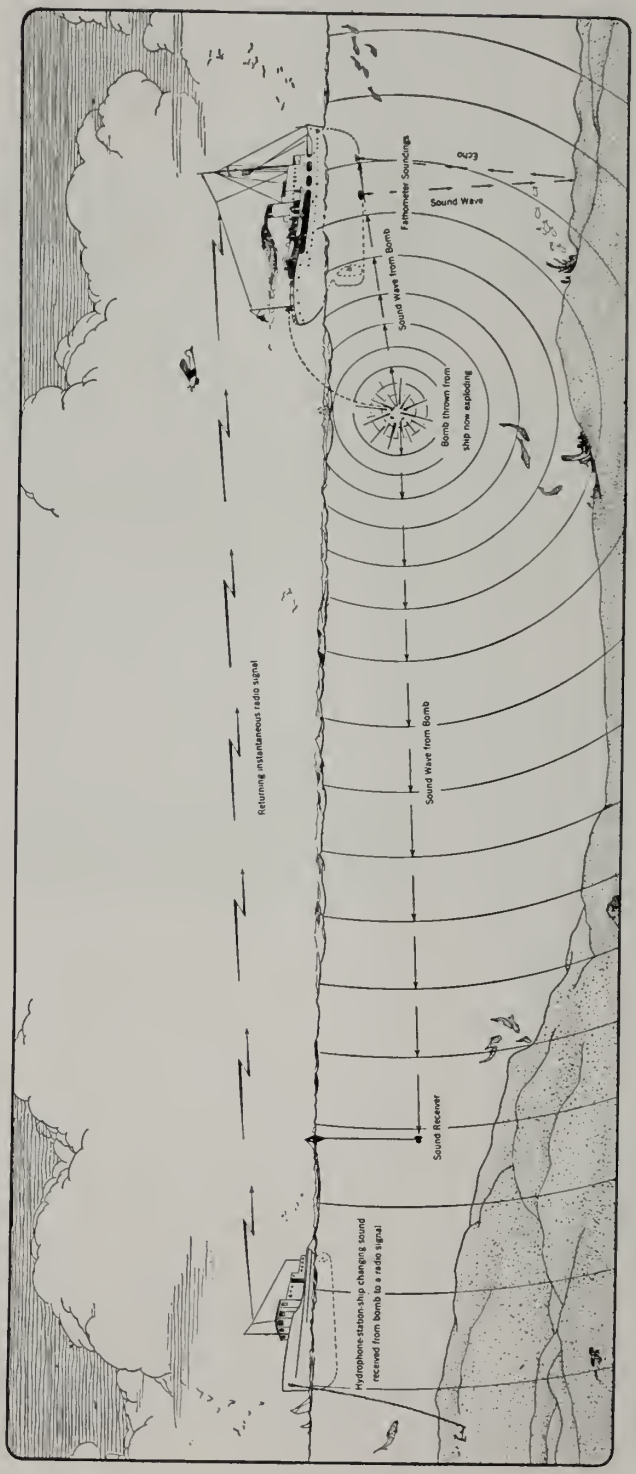
While the job is far from complete, much work has already been accomplished, with control surveys carried out to some extent in every State. Our own Federal system has been extended by the Canadian and Mexican Governments, so that the whole American continent now has a uniform basis of control, known as the North American Datum.

Bilby Tower Used in Survey Work.

Preparing to dismantle a 116-foot steel portable triangulation tower for transportation by truck to the next station. Many of these towers, designed by a member of the U.S. Coast and Geodetic Survey, are in constant use by field parties engaged in geodetic control surveys, as they overcome interference in vision due to the curvature of the earth, forest growth, etc. The inner tripod structure supports the theodolite used in measuring the angles of triangulation. The outer tripod, independent of the other so as not to disturb the instrument, is for the observer and recorder, or lightkeeper.

HYDROGRAPHIC AND TOPOGRAPHIC SURVEYS

With control points available in the area under survey, the work of gathering the information required for charting purposes can be begun. A strip of topography extending a short distance inland is usually shown on the chart, and back of this only important landmarks visible at sea are included, as nautical charts are published primarily for navigational use. Older methods of topographic mapping, including the plane table which for many years has been the principal instrument used by the Bureau for this work, are now being supplemented to a considerable extent by the use of aerial photographs.



Fathometer Soundings and Radio Acoustic Ranging.

Showing two of the scientific methods employed by the Coast and Geodetic Survey of the Department of Commerce to insure on nautical charts (1) correct water depths and (2) the precise positions of such depths, many of which are given for water areas far out of sight of land. Depths are determined with a fathometer, which measures the time required for a sound to travel to the sea bottom and return to the ship as an echo. They are made at the rate of 4 per second, while the survey ship proceeds back and forth over the area at her regular speed. The positions of these depths are fixed by radio acoustic ranging, from two previously determined positions, such as two station ships (of which one is shown). The time elapsed between the sound from the bomb as received on the survey vessel, and the radio wave from the station ships, is measured on the surveying ship to one one-hundredth of a second. Knowing the velocity of sound in water, the distance between the survey ship and each of the two station ships can be calculated accurately, even when separated by as much as 100 miles.

The nautical chart might be described as a topographic map of an area which has been flooded to the elevation of the contour represented by the shore line. Information concerning the water area of the chart is obtained by hydrographic surveys, which include the measurement of depths, the determination of the geographical positions of such depths, and the location of shoals, wrecks, aids to navigation, and similar features.

Various classes of vessels are utilized in this work, ranging from sea-going survey ships, in the offshore areas, to small launches or pulling boats for the work close to shore. A variety of methods for measuring depths and determining the position of the survey vessel are available for use, depending on the depth of water and the distance of the work from shore. In some regions where there are submerged dangers of small extent, such as pinnacle rocks and boulders, it is necessary to use a special apparatus called the "wire-drag," to make sure that all such features have been discovered by the survey. Hydrographic work is controlled with respect to location by the geodetic surveys in the vicinity and is closely related to the latter as well as to adjoining topographic surveys.

The diagram, page 20, graphically portrays two of the scientific methods employed today for hydrographic surveying. These and other developments have enabled the Bureau during recent years to cut the cost of its work nearly in half.

TIDE AND CURRENT SURVEYS

The tidal work of the Survey serves a number of important purposes. With regard to chart production, tide observations are essential for the establishment of a reference plane for the soundings which necessarily are taken at all stages of the tide. In every hydrographic survey, therefore, tide observations are a basic requirement.

In modern commerce, with its deep-draft vessels moving on exacting schedules, it is also a prime necessity to know the times and heights of the high and low waters. For this purpose the Survey issues in advance yearly tide tables, which give daily predictions at the more important ports and tables for deriving predictions at numerous other places. These predictions are based on involved mathematical principles, but a machine has been devised which does this laborious calculation mechanically.

Tides are produced by the gravitational effects of the moon and sun, the magnitudes of which are a matter of calculation according to known laws. The resulting tides, however, are so profoundly modified by the hydrographic features of different oceanic basins that the tides at various places differ strikingly in time, in range, and in characteristics of rise and fall. Consequently the actual tides as they occur in nature must be observed to determine their characteristics for prediction purposes. For this purpose the Survey maintains a number of primary tide stations, in continuous operation at strategic points, from which the tides of an extensive surrounding region can be deduced.

The basic datum of elevations for our country is that of mean sea level; that is, the level at which the waters of the oceans would come to rest if freed from all disturbing influences of tides, winds, weather, and varying atmos-

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pheric pressure. The initial points for the entire network of first-order leveling which covers the country is mean sea level at a number of points along the coast as determined from tide observations covering a number of years. The primary tide stations thus serve at the same time as the initial points from which the network of levels starts.

The rise and fall of the tide is accompanied by a horizontal backward and forward movement of the waters in the form of a current. While various other factors usually contribute to the currents actually encountered in nature, the tidal current is an important one as regards navigational operations. Therefore, current tables are issued yearly in advance, giving information with regard to the times and velocities of the tidal currents.

Tidal current charts also are published for important harbors, good for any year, giving the direction and velocity of the current at high and low water and hourly thereafter, an important aid in waters congested with traffic.

MAGNETIC SURVEYS

Field operations required for the production of charts also include magnetic surveys, in order to provide the data relative to magnetic variation, shown on all nautical charts as "compass roses," for the purpose of making it easy to use the magnetic compass in steering desired courses. To secure this information the Survey has made observations at some 6,000 places scattered all over the country. The change in the earth's magnetism from year to year is determined by continuous observations at five magnetic observatories, supplemented by short-period "repeat" observations at secondary stations in all States of the Union, and at suitable intervals along the seacoast.

OFFICE COMPILATION

After the completion of the varied field surveys, a considerable amount of office work remains to be done. The data are subjected to a careful review and to various checking processes, including the plotting of all hydrographic work on accurate projections, called "smooth sheets." After all available information is assembled, it is combined and abstracted in the form of a drawing of the proposed chart, which is again carefully verified before it is photographed and transferred to an aluminum plate from which the chart is printed in the Survey office.

The results of all activities in which the Survey is engaged are also compiled for printing. In addition to the Tide Tables and Current Tables which have been mentioned, these include the various United States Coast Pilots published for the mariner. Each of these latter volumes covers a particular area and contains detailed information that cannot be shown conveniently on the nautical chart, relative to the shore line, port information, sailing directions for coasting and entering ports, and general information as to weather conditions, radio service, etc. Supplementing all these data in the interest of safety is the weekly Notice to Mariners, issued jointly with the Bureau of Lighthouses, to keep mariners advised of changes continually taking place, that they may keep their charts and Coast Pilots current.

The Survey likewise issues numerous annual and special publications on the results of its operations and researches, in triangulation, leveling, tide datums, terrestrial magnetism, seismology, special tide and current studies of particular harbors and rivers, and manuals covering its various fields of work.

EARTHQUAKE SAFEGUARDS

When the Federal Government began to take an active interest in the economic and social aspects of the earthquake problem, the function of carrying out the program was vested in the Coast and Geodetic Survey, since seismographs already were in operation at its magnetic observatories. The subject is becoming of rapidly increasing importance with the growing density of population and volume of investment in structures exposed to possible damage.

The work carried on by the Survey serves as a nucleus for cooperating with and coordinating the local efforts of various public and private organizations also engaged in such studies. In no way competing, the Survey conducts investigations in areas not covered by them. While earthquakes cannot be prevented, there are many ways in which, because of our increasing knowledge gained from analyses of the comprehensive records obtained from instruments installed in regions subject to shocks, precautions may be taken to prevent their maximum detrimental effects. Results already obtained have been used in designing many different types of structures, especially those connected with very large projects financed in whole or part from Federal funds.

CHARTS FOR THE AVIATOR

A comparatively recent safety aid assigned the Survey is the preparation and printing of special charts for air navigation, using the basic control survey and other data and facilities for printing available in the Bureau. They are designed for quick reading by the pilot in a rapidly moving plane, showing altitudes, radio ranges, revolving and flashing beacons, airports, towns, prominent high-tension lines, railroads, streams, lakes, and other features, lithographed in a number of colors for emphasis. They also show "compass roses" and other means of finding compass bearings.

The strip airway maps, which were first published, cover a section 80 miles wide between the terminals of established airway routes. These, however, are being replaced gradually by a series of 87 sectional aeronautical charts, each embracing an area of 2° of latitude and 4° of longitude, as the latter comprehensively cover more ground area and provide for a large amount of flying off the commercial airways. When completed, these 87 sections can be fitted together to form one composite map of the United States.

INFORMATION VALUABLE FOR OTHER PURPOSES

The facts gathered by the Coast and Geodetic Survey in connection with its charting and mapping activities have many collateral uses. To carry on harbor or waterfront improvements without authentic, comprehensive information about water depths and changes in tides and current would be as wasteful as

haphazardly constructing a massive building without the benefit of previously prepared plans. It would be just as wasteful to carry out any engineering project covering an extensive area, or to locate boundary lines of countries, States, and municipalities, without utilizing geodetic control data; or to construct buildings in earthquake areas without making use of available studies in seismology.

Geodetic data are therefore available as vital cost-reducing factors in engineering and industrial operations such as water-power development, drainage and irrigation projects, flood control, highway location, boundary lines, and the like.

Tide and current observations serve primarily to furnish basic charting data. With thousands thronging the seashore summer resorts, the predicted tides are also constantly referred to by parties planning outings and fishing trips. In addition, they are invaluable to the engineer and scientist confronted with problems relating to the rise and fall of the tide and the accompanying current.

Terrestrial magnetism is one of the most important yet elusive forces of nature. Investigators in our great scientific institutions and the research departments of our great corporations, are constantly pressing forward in their efforts to utilize this force for the benefit of mankind. For the data which constitute the foundation for such research work in the United States, these scientists look to the Coast and Geodetic Survey. Magnetic methods, based on past and present surveys, continue to be utilized in studying geological structure, especially with reference to the search for oil and minerals. Surveyors engaged in the retracing of land boundaries determined by compass many years ago depend largely upon the observations of this Bureau for information regarding the change in the direction of the compass needles with lapse of time. A comparatively recent discovery is that the quiet or disturbed condition of the earth's magnetism has a definite relation to radio transmission.

Hydrographic and topographic surveys are usually made on larger scales and show more details than the finished chart. Successive resurveys of changeable areas also furnish a record of changes of great value in planning waterfront development and protection and in settling litigation concerning such properties. Copies of original sheets, furnished at a nominal cost, are in considerable demand.

Thus the varied products of the Coast and Geodetic Survey constantly grow in importance with the increasing needs of our people and the spreading knowledge of the many purposes for which they can be used to advantage. Its labors must continue with unabated vigilance so long as the waters flow, earthquakes occur, and changes are made by man and nature. Such very necessary services do not show themselves directly by dollars-and-cents returns, but they reveal their value in the untold wealth of added security to life and property on land and sea.

To make immediately available to interested persons the results of its various activities, the Coast and Geodetic Survey maintains a mailing list of persons and firms desiring to receive notice of the issuance of charts and of its many other publications. Those desiring this information, should write to the Director, U.S. Coast and Geodetic Survey, Department of Commerce, Washington, D.C., for the mailing-list circular.

BUREAU OF FISHERIES

FRANK T. BELL, Commissioner

When the Pilgrims came to this country they regarded the untouched resources of their adopted land as boundless. They felt that especially inexhaustible were their newly discovered fisheries—a fishery being defined as the total fish population of a certain species or a certain area. Their earliest accounts told of the bountiful supply of fish in streams and lakes of North America. So numerous were the leaping, gamy salmon and trout, the shad, the river herring, and other native species, found in the coastal rivers in silver hordes, that scarcely any effort was necessary to take large quantities of them. As a result, fish formed an important element in the food of the early settlers, and later of the western pioneers.

As long as there were still plenty of new streams and lakes to explore and fish, man retained his idea of the limitlessness of the supply and the inalienability of his right to fish when, how, and as much as he desired. As the country became more settled and fishing effort more intensified, the people were faced with new facts and new concepts. Much to their surprise and consternation they learned that too much fishing in their immediate locality put drains on this natural resource which could not be replaced in a natural way as long as that excessive drain prevailed.

Eventually the alarm spread to Congress. In 1871, by congressional enactment, there was established a Fish Commission to look into the apparent diminution in the supply of fish and to propose remedial measures. This Commission began its battle to aid nature in keeping up the supply of the fish at that date, and that battle has continued up to the present time. In the meantime the organization entrusted with this charge has had its name changed to the Bureau of Fisheries and has become a part of the Department of Commerce.

This struggle—although the drain on the fisheries has increased constantly since it first began—has not been a losing one. True, certain fisheries and certain streams and lakes have been overfished almost to the point of extinction, but generally over the country as a whole the fisheries have held their own fairly well. The commercial fisheries have increased to a point where they returned to the fishermen $55,000,000 in 1932, even though the price was at a low point in that year, and they furnish employment to about 116,000 fishermen. In the meantime the Americans who enjoy fishing for sport have been increasing rapidly, with the result that a proportionately enlarged burden has been imposed on the fisheries of our lakes and streams. It is estimated that there are about 10,000,000 anglers in this country today. Despite this added and still increasing load the fisheries have been maintained; and indeed a new

concept, particularly for the recreational fisheries, has come in: We must not only maintain that supply but actually increase it, that everyone who so desires may have more and better fishing.

REHABILITATING AND CONSERVING THE FISHERIES

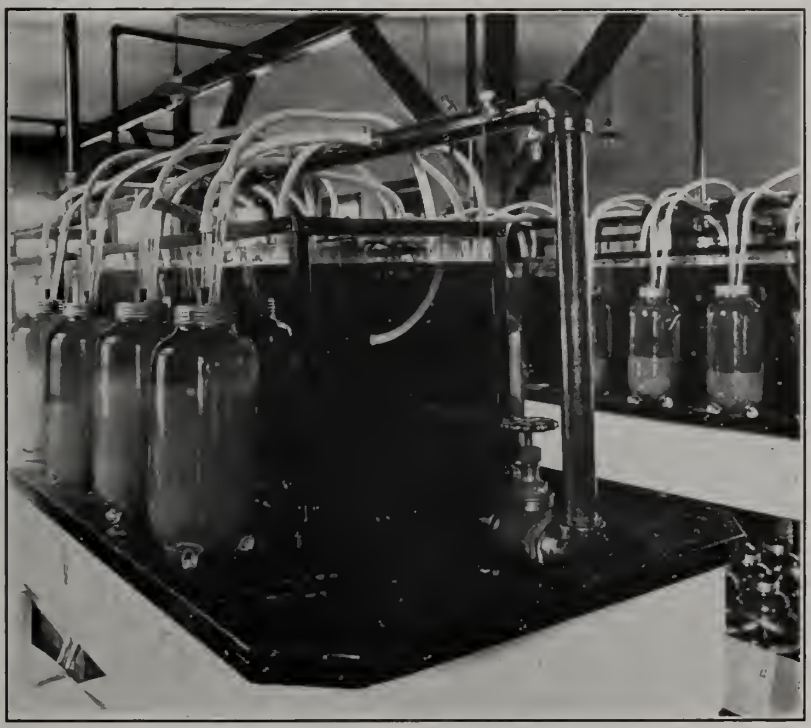
In order to rehabilitate a fishery the Bureau must first of all know the fish itself, its habits, and its surroundings. It must study as well the natural enemies and the fishes' ability to resist them. These things call for many scientific investigations that often appear purposeless to the casual observer but are in fact the foundation upon which the corrective measures must be based. It might seem foolish at first glance for a scientist to release thousands of small bottles in the ocean and then pay a reward for the return of the contained tags. These experiments, however, enlighten us on the ocean surface currents—their direction, rate of flow, and other factors. Having this information and such essential facts as the spawning time and place of different fish, we can determine where the eggs and young of these fish will be carried by these same currents before they reach an age to shift for themselves. Thus fish spawning on one bank may stock another bank hundreds of miles away. Scientific studies also point the way to protective legislation for the States or in some cases to treaties between nations. If it is established that a closed season covering the spawning period will achieve the results, then that regulation of the fishery is all that is necessary.

A study of methods affecting the particular fishery may suggest that the regulation of gear used, either through prohibition of certain types or the modification of others, will not only save this species of fish and build it back to normal but in addition return greater profits to the fishermen as well. Hence, every detail that enters into the actual taking of fish must be carefully analyzed.

It might seem that it would be an impossible task to restock an ocean with fish, and so it is, but certain species in that ocean may be greatly aided by this method. If, for instance, a given variety of fish go up rivers for spawning, the Bureau's men can take the eggs from fish caught for food or market, and after hatching them under ideal conditions, protected from enemies, return to the river, and thus eventually to the ocean, millions of young fish that would otherwise never have hatched.

In the sports fishery of our interior waters, the Bureau enters into restocking to a much greater degree. It is much easier to take all the fish from a small body of water than it is from an ocean, and likewise it is much easier to reestablish that species of fish in the small body of water when it has been overfished. Hence the Bureau maintains about 60 hatcheries for the purpose of restocking streams or lakes which are depleted or are exhausted. It is the constant endeavor of these hatcheries to release larger, stronger fish—fish that will have the very best chance of growing to maturity. The scientist is constantly at work trying to improve these strains through a study of diets, selective breeding, and many other methods.

With our changing industrial methods over the country, many conditions come about that affect the habitat of our fishes. Often waters become unsuitable for the fish which once thrived therein. To restore these waters to their natural state is then a problem that confronts the Bureau more and more. Streams and lakes must be surveyed, pollution studied both with a view to removing it as such and utilizing, if possible, the pollutant in such a way as to benefit the fishery. Dams may be built in a river which will produce an entirely different set of conditions, all of which must be met. The dam might merely serve as an



Equipment Utilized in Hatching the Eggs of Shad.

Approximately 100,000 shad eggs are placed in these jars and kept in gentle motion by a current of water introduced at the bottom. The eggs hatch in a few days, the exact time being dependent on the water temperature.

obstruction to such migrating fish as the salmon which go up the river to spawn. Because of their "homing instinct" of only spawning where they were hatched, it is essential that fishways be constructed so that that entire race will not be wiped out. Again the dam may change a cold-water stream supporting trout to a warm lake where trout could not exist but where bass would thrive. The Bureau then must study and meet these conditions.

In all this work the Bureau is without regulatory powers. It seeks causes of depletion and on finding them suggests remedial measures to the States or industries interested, so that they in turn may regulate or provide the corrective measures. In Alaska, however, the Bureau has regulatory authority. Here

waters are closed as necessary to maintain the fishery, and streams that are depleted are gradually restocked. The gear with which the fishing is done is regulated and even the amount of fishing effort prescribed. Closed seasons and closed periods during the week are also applied to build up threatened depletions. As a result the future of the fisheries of Alaska seems well assured.

How does the Bureau learn of threatened fisheries? It annually takes a census of the commercial fishes. It cannot actually count each fish in the sea or lake, but knowing the number caught and the effort expended in getting them it can estimate the number of fish actually present. Sometimes its picture of that fish population is so clear that it can predict with reasonable accuracy the number which will be taken the following season. Some of its staff are engaged in collecting and compiling these statistics of the fisheries. These facts, when published, are of especial interest and value to those engaged in the industry.

The Bureau, however, does not cease its efforts when it has restored a fishery and has obtained the necessary balance for it to maintain itself. Conservation means far more than that. It means, as well, a wise full use of the product taken. The Bureau, therefore, is continually seeking new uses for these fishery products—the country's primary source of vitamin D—and a complete usage of all waste products. It hopes that every particle of the fish will be utilized. Today even the scales and fins of some fish are used, and the waste flesh is converted into animal feedstuff. The nearer we can approach such complete usage for all fishes, the nearer we are to true conservation. The Bureau attempts, furthermore, to perfect methods of production of fish oils, fertilizer, meals, etc., and careful investigations by trained scientists are made to improve the resultant product and find new uses for it. Whole industries must be surveyed to eliminate wastes. Storage, refrigeration, handling, shipping, wholesaling, and retailing all must be carefully checked to present the consumer with a better, fresher product.

Gear and fishing equipment are studied and improved with a view to the new concept of conservation as well as to render a service to the fishermen. Many types of gear, used in obtaining the catch desired, destroy immature fish, thereby constituting a tremendous drain on the fishery. Improvements that eliminate this wastage of both fish and labor, are, of course, heartily welcomed by fishermen. Studies that bring about longer life for nets and equipment also are taken up by Bureau scientists, with the thought that this saving to the fishermen is of direct benefit to the entire country.

FUR SEALS OF THE PRIBILOF ISLANDS

The Bureau of Fisheries also has charge of the fur seals of the Pribilof Islands. This herd is the largest in the world, numbering at present more than 1,300,000 animals. When the Bureau took over the control of this resource in 1911, it numbered less than 200,000 seals. During this period the Bureau has built up the herd to its present size and at the same time has secured for manufacture a yearly increasing number of skins. The herd is increasing at the rate of 8 percent annually, despite the fact that in the summer of 1933 the take of surplus

males exceeded the large figure of 54,000. When the Bureau took charge, the fur seal was rapidly nearing extinction. Not only has the herd been reestablished, but this valuable and interesting animal has been saved for posterity.

When the United States acquired the Pribilofs with their fur seals, it became guardian to the natives residing on these islands. The natives are, for the most part, the descendants of the people taken to the Pribilofs by the Russians soon after the islands were discovered, although a few others have established residence there from time to time. In return for their services, primarily in the fur-seal industry in summer and foxing operations in winter, they receive

Fur Seals, Pribilof Islands, Alaska.

A number of interesting names have come into general use in connection with fur seals. Mature males are called "bulls," mature females are "cows," immature males are "bachelors," and the young of the season are "pups." The breeding ground is a "rookery" and the family group is a "harem."

from the Government living quarters, fuel, food, clothing, schooling, and medical attention, plus a nominal fee for each skin taken. Hence we find the Government, through the Bureau of Fisheries, building houses and schools; transporting and distributing supplies; furnishing doctors, dentists, and schoolteachers; and generally caring for the natives. For those who have a surplus, the Commissioner of Fisheries acts as banker. At present there are about 385 natives on the islands, living in two villages—one on St. Paul Island and the other on St. George Island.

From the care of these natives, in the one extreme, the work of the Bureau of Fisheries extends to the promotion of a great industry and the preservation of a great sport, aiding both the commercial fisherman and the amateur angler, and, in the last analysis, benefiting the ultimate consumer.

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BUREAU OF FOREIGN AND DOMESTIC COMMERCE

ALEXANDER V. DYE, Director

The Bureau of Foreign and Domestic Commerce may be regarded as the central switchboard of American business. On the one hand, it is reaching out in a constant study of the field of production; on the other, it keeps up diligent search for markets where that production may be sold. Yet a task of that magnitude cannot be accomplished as simply as it can be stated. To be able to render that sort of service to American business it is necessary for the Bureau to be the country's Number One fact-finding agency in all matters relating to the business and economic life of the Nation.

The Bureau of Foreign and Domestic Commerce maintains 24 district offices in the United States, and through them has connections with 54 other cities. These district offices are the feelers, or the wires, which reach out from the central switchboard into the realm of production. All available information on the business and economic life of the country is sifted through these offices and forwarded to Washington, where expert economists and analysts fit them into the whole picture of industrial America. These officers likewise make available to the business interests of their respective sections trade information originating from foreign countries and from research activities carried on in Washington.

In foreign countries the Bureau maintains 32 offices where information is being constantly sought relative to marketing conditions throughout the world. This information is sent back to the Washington office and there fitted into the economic picture which is continuously being constructed by the staff of business experts.

When this mass of economic data is gathered and compiled, it is available not only to American business men but is designed to keep the Government of the United States informed on current economic developments throughout the world. It is the purpose of the Bureau to supply the basic figures for long-range planning on the part of individuals and public agencies, and to encourage and stimulate sound development in industry and commerce.

Scarcely any other agency has the same breadth of activity as the Bureau of Foreign and Domestic Commerce in the field of general economic research, but its ultimate benefit to American business can be measured only by the extent to which American business men themselves use the Bureau. It can gather and compile the data, but it cannot always anticipate individual business problems. To that end, it would broadcast an appeal to the business men of the Nation to use the facilities of the Bureau as freely and as frequently as they desire.

THE FOREIGN SERVICE

The Bureau maintains, for gathering basic data concerning foreign markets, a trained staff of experts with offices in 32 commercial centers throughout the world:

Athens, Greece.
Batavia, Java.
Berlin, Germany
Bogota, Colombia
Brussels, Belgium
Buenos Aires, Argentina.
Cairo, Egypt.
Calcutta, India
Copenhagen, Denmark.
Habana, Cuba.
The Hague, Netherlands.
Istanbul, Turkey.
Johannesburg, South Africa.
Lima, Peru.
London, England.
Madrid, Spain.
Manila, P.I.
Mexico, D.F., Mexico.
Ottawa, Canada.
Panama City, Panama.
Paris, France.
Prague, Czechoslovakia.
Rio de Janeiro, Brazil.
Rome, Italy.
Santiago, Chile.
Shanghai, China.
Singapore, Straits Settlements.
Stockholm, Sweden.
Sydney, Australia.
Tokyo, Japan.
Vienna, Austria.
Warsaw, Poland.

Regular and detailed reports from these offices, reports of a commercial nature prepared with the highly valued and hearty cooperation of the consular officers, special studies made here and abroad, scores of statistical and factual compilations on economic subjects, together with significant tabulations made by agencies or organizations all over the world, are collected in the Washington headquarters of the Bureau.

DISTRICT OFFICES

To guarantee the closest possible contact with American business, and to supply in the most effective manner its officials and analysts with the pertinent information which it has compiled, the Bureau of Foreign and Domestic Commerce has established district offices in the following cities throughout the United States:

Atlanta, Ga.
Birmingham, Ala.
Boston, Mass.
Buffalo, N.Y.
Charleston, S.C.
Chicago, Ill.
Dallas, Tex.
Detroit, Mich.
Houston, Tex.
Philadelphia, Pa.
Portland, Oreg.
San Francisco, Calif.
Jacksonville, Fla.
Kansas City, Mo.
Los Angeles, Calif.
Louisville, Ky.
Memphis, Tenn.
Minneapolis, Minn.
New Orleans, La.
New York, N.Y.
Norfolk, Va.
Pittsburgh, Pa.
St. Louis, Mo.
Seattle, Wash.

There are cooperative offices (usually in connection with a chamber of commerce or board of trade) in 54 other cities.

These offices are frequently and accurately described as "service stations" of the Bureau. They perform such services for the trader, the manufacturer, or

dealer as: indicating the location of a foreign market, the means of entering it, the difficulties and technicalities involved; furnishing lists of buyers or sellers; pointing out shipping routes; discussing general competitive and economic developments; and, in short, placing before American business on an immediate-delivery basis the wealth of information which the Bureau of Foreign and Domestic Commerce has gathered and organized for its benefit.

To correlate, analyze, and interpret the material which it gathers and to organize and publish it in a form which can be used alike by other agencies in the Government and by American business, the Bureau has set up in Washington a complete organization divided into sections, each with its own field of study. Some of their functions are outlined in the succeeding paragraphs.

COMMODITY DIVISIONS

To keep abreast of the swift changes taking place in individual industries, to correlate the endless supply of facts at home and abroad, the figures and specialized problems relating to them, the Bureau maintains 12 commodity divisions, consisting of experts conversant with the details of a given industry. These commodity divisions are:

Automotive—Aeronautics Trade
Chemical
Electrical Equipment
Foodstuffs
Industrial Machinery—Agricultural Machinery
Iron and Steel
Forest Products
Minerals
Leather—Rubber—Shoes
Specialties, Motion Pictures
Textiles
Tobacco

They bring the Bureau into direct and vital touch with producers and dealers, making possible the establishment of mutually helpful relationships, with keen responsiveness on both sides. For each industry there is provided a highly specialized service, satisfying some of its peculiar and characteristic needs for statistical and other information. Necessary and valuable data are gathered quickly under competent supervision, and material is disseminated to the many trades in the most efficient ways that can be devised.

TECHNICAL SERVICES TO BUSINESS

Besides the commodity divisions, rendering services to specific groups, there are in the Bureau "technical" divisions, devoting intensive study to special phases of economic effort. To inquiring industry they can supply information not otherwise obtainable on some of the highly specialized aspects of the economic system.

The ever-changing and complex field of tariff barriers and regulations calculated to control the flow of goods between nations is the special subject of the Division of Foreign Tariffs. This organization, making available the current picture of tariffs, quotas, trade agreements and treaties, and foreign-commerce regulations of all sorts, is unique in America in the service it offers.

Similarly, the legal requirements which confront the American trader abroad are the special topic for study by the Commercial Laws Division. To make plain foreign nations' legal requirements, to keep American business interests aware of the legal changes and developments which may have an effect on them, and to make comparative studies on legal topics of the widest range are but a few of the daily functions of this highly specialized division.

The Division of Finance and Investment serves as a clearing house of information on the swiftly moving changes in monetary, financial, and budgetary developments in foreign nations. Its studies on such matters as blocked accounts (which are of particular current significance), exchange procedure, balance of international payments, national indebtedness, foreign-trade financing, and American investment abroad are accepted as definitive throughout the Nation.

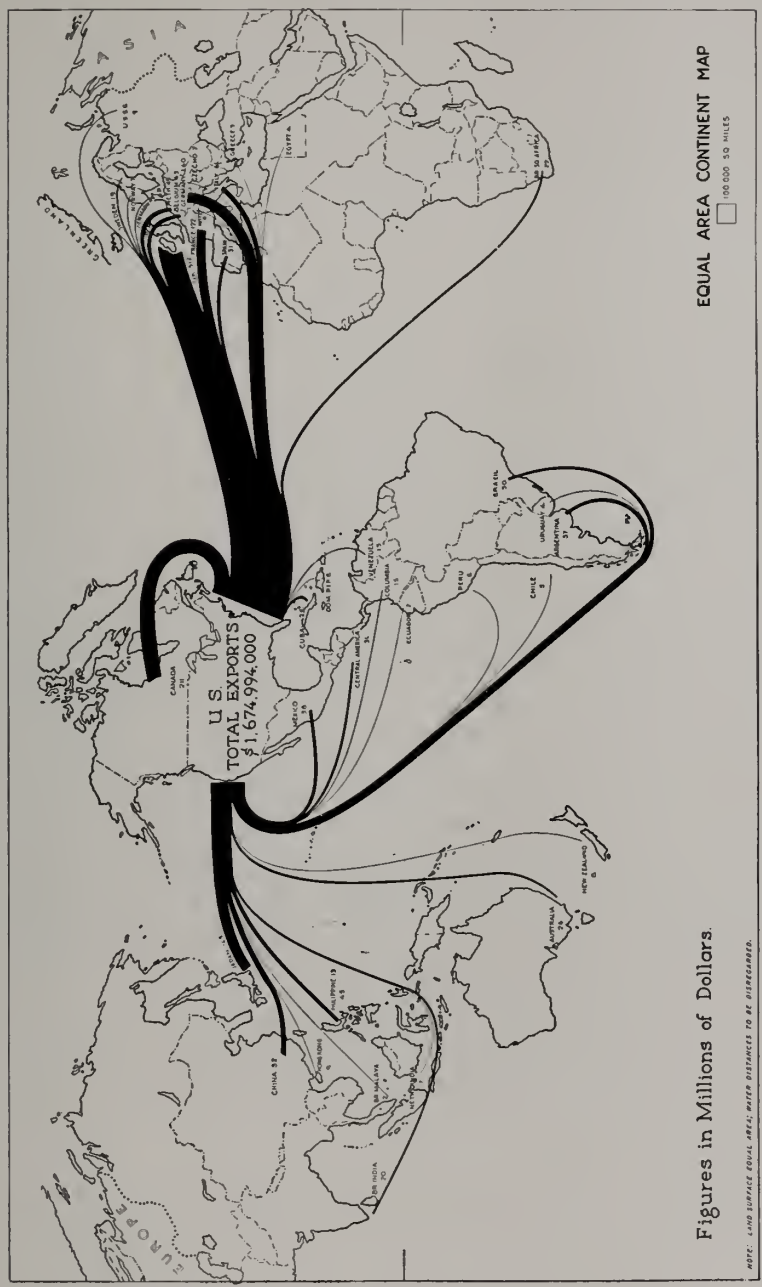
The function of the Bureau's Commercial Intelligence Division is to supply names of foreign importers and exporters and sales information regarding such firms. Information on more than 600,000 individual business concerns abroad is classified by country and kind of business, available for use by American commercial concerns, which are thus supplied with information on buying terms and on the essential characteristics of the traders and firms with which they may enter into transactions abroad.

The Division of Transportation and Communication also serves business by collecting and disseminating basic data relating to ocean and land shipping, trade and cable routes, rates, charters, port and harbor conditions, and other relevant details of transportation at home and abroad. It also deals with telephone, cable, radio, and postal communications in relation to commerce, and is equipped to advise the Government by special studies on such subjects as potential traffic, inland waterways, and ship and railway operating costs.

The staff of experts in the Regional Information Division might be referred to as the "chart plotters" of the economic conditions of the world, supplying the figurative maps by which American trade and commerce may be guided through the fogs and mists of international business conditions. Their task is to correlate the continual flow of statistics and information on general business conditions abroad and trends in foreign markets, as furnished by officers in the foreign service and other sources, and to compile the material in a form which shows the current economic picture of the world.

Figures on our own foreign trade are compiled by the Division of Foreign Trade Statistics. Determining not only the volume, value, origin, and destination of our imports and exports, it also analyzes in detail general trade movements and commerce in specific commodities.

Balancing the work done in foreign fields are the studies relating to domestic trade. One of the statistical nerve centers for United States commerce and industry is the Division of Economic Research, which, on the basis of figures and facts gathered by the Bureau, by other departments in the Government, and by private sources, offers facts vital to economic long-range planning. It analyzes the so-called major "statistical indicators" and as a result of its studies formulates reports of major significance and of valuable aid to Government agencies engaged



Distribution of United States Exports in 1933.

Statistics of American foreign trade, tabulated in detail to show origin, destination, value, volume, and type of imports and exports, are compiled by the Bureau of Foreign and Domestic Commerce.

in guiding and coordinating economic policies of the Nation. A research project of paramount importance to domestic economy recently completed at the request of Congress by this division was the National Income Study showing the trend of our national income from 1929 through 1932, including the distribution of income by sources, such as agriculture, industry, etc., and by type of payment, such as returns to labor or from income and wages.

While the Division of Economic Research shows statistically what is happening, day by day, in the economic development of the United States, the work of the Marketing Research and Service Division, on the other hand, is to formulate definite and specific recommendations for guiding and encouraging that development. By its intensive research in special subjects it is able to give direct advice to individual trades and to supply clear indicators to the Government on some of the questions arising from economic planning. Its detailed studies in market indexes, consumer markets, advertising, trade associations, its surveys of credits and other topics, amplify the ability of the division to make sound and tested advice available to American business and public agencies.

Another Division is that on Negro Affairs, which is specifically concerned with the problems and welfare of the Negro in trade and commerce.

DISTRIBUTING INFORMATION

Collecting information, gathering data, analyzing statistics, and projecting studies would be of comparatively little value did not the Bureau of Foreign and Domestic Commerce have means of making the results of its work available to those who can use them. The Bureau's method of disseminating its material is fourfold—first, by direct contact with the Washington office; second, by means of its "substations," both in this country and abroad; third, through the medium of its extensive publications; and fourth, through the daily and trade press.

Thousands of direct inquiries to the Bureau are answered by letter each month. Personal conferences and meetings with individuals seeking information also serve to augment the effectiveness of the Bureau, while addresses of a public or semipublic nature by its officials bring to thousands of people the valuable information derived from the Bureau's work.

By the printed word, however, is American business most widely served. Over desks of the Editorial Division of the Bureau passes a varied flow of manuscripts to the printer, so that individuals, businesses, research institutes, universities, and Government agencies may be supplied with the cold facts and hard figures they need.

Among the regular publications of the Bureau, prepared by its various divisions, are Commerce Reports, a weekly journal, giving a running-fire résumé of business activities and prospects abroad, sketching the latest developments in tariff, legal, and business conditions as outlined in the reports of the officers in the Foreign Service and in the foreign periodicals which are received in Washington. Foreign Commerce and Navigation of the United States is an annual

publication, dealing in statistical completeness with the exports and imports of the United States by articles and countries. The Monthly Summary of the Foreign Commerce of the United States is the current counterpart of the foregoing, and shows in its tables a less detailed but more timely summary of our trade with other nations.

The Statistical Abstract of the United States is an annual volume containing in condensed and convenient form a very wide range of statistical tables prepared by agencies of the Government during the year. The Survey of Current Business, published monthly with a small weekly supplement, gives the basic and current figures of industry and trade in the United States. While it is largely statistical, a short text analyzes the month's developments in general and also in specific fields.

Besides these periodicals, numerous irregularly issued publications are compiled each year. These deal in the main with specific phases of trade promotion, with studies of given commodities and industries, or with discussions of current features and developments in specialized fields. The commodity and technical divisions also issue at frequent intervals mimeographed bulletins containing "spot news" of immediate interest in a specific foreign market, trade problem, or commodity. The subject matter of these bulletins and publications and the treatment which such material receives is guided by the needs and specific requests of private business and commercial organizations seeking information in definite fields. There is also the Domestic Commerce bulletin, issued three times a month, which presents the latest developments in this country in the fields of distribution, research, and commercial practice, collected from Government and private sources.

In emphasizing the extent of its service to the business interests of the country, the part which the Bureau plays in aiding other Government agencies must not be overlooked. In this age of long-range planning, the Bureau of Foreign and Domestic Commerce finds itself continually in a position to supply basic figures and fundamental analyses to other branches of the Government for their use in encouraging sound economic development on the foundation of accurate information.

LIGHTHOUSE SERVICE

HAROLD D. KING, Acting Commissioner

Hawaii, the crossroads of the Pacific, is now far astern, 2,000 miles and more away. Bound in from the Orient, on the southerly track from Honolulu, one of the crack ships of the Pacific is standing in for the bold California coast. The master is anxious to fix his position definitely, for during the past 2 days the weather has been such that no observations were possible, and there may be fog ahead. Steaming out of Honolulu, and through the Kaiwi Channel, a departure had been taken from the Makapuu Point Lighthouse on the southeastern end of the island of Oahu. Forty miles out, the flashing white light of Molokai was seen on the starboard beam, and all during the night the radiobeacon at Makapuu could be heard, its bearing being over the stern. But from then on, the ship's position had been determined only by sights and by dead reckoning, and now for two days there have been no sights, the sky being entirely overcast, yet the coast is just ahead.

In the public rooms of the ship 1,000 persons are engaged in the gayeties of the last night aboard, for tomorrow they will land in San Francisco. Little groups are talking about the jagged pinnacle rocks known as the Farallon Islands, about the San Francisco Lightship, and the appearance of the new bridge which is to span the majestic Golden Gate. On the bridge of the vessel, shrouded in darkness, the navigating problems are being worked out which will terminate the voyage in safety.

At 11 o'clock, the festivities are interrupted by wisps of damp fog which begin to blow along the deck. The awning stanchions, rail, and deck houses are soon dripping wet, and then the air is split by the loud roar of the fog whistle high up on the stack.

Unnoticed by the passengers, the vessel's course has been changed somewhat, not because of the fog, but because the ship has come within the range of a radiobeacon signal. The navigating officer has the headphones of his radiocompass on. He is listening intently, and slowly turning the handwheel before him. "Dash, dash," faintly at first, and then, with the turn of a dial, a little louder, "dash dash," San Francisco Lightship is heard 100 miles away. At frequent intervals through the night, these radiobeacon signals are picked up, and, by them, the ship's course is laid straight for the Golden Gate. It is shortly before 2 in the morning that another radiobeacon signal is heard, the "dot dash dot" of the station on the Farallon, and with this as a check, the navigator knows exactly his position.

By 3 o'clock the diaphone fog signal of the Farallon Light Station can be heard, a blast followed by a group of two blasts, forming "12." It is on the port

bow but swings farther to port and becomes louder and louder. As the ship progresses, the dark outlines of the high cliffs appear for a moment, and, in the gray light of morning, the beams from the lighthouse can be seen.

Ahead again there is another signal, but with a different note. It blows for 2 seconds and is then silent for 28. This is the big steam tyfon fog signal on San Francisco Lightship. A shift of the wind has now carried most of the fog away, and before the incoming ship is abreast the lightship the fog has disappeared, revealing the vessel's red hull. Its masthead light is still burning, and on its side are the large white letters "SAN FRANCISCO."

At 5 o'clock, the little lightship has been left astern, and the homeward-bound vessel is passing through the channel marked by lighted buoys on either side and leading across the bar to the harbor. Straight ahead, a cleft in the bold bluffs, is the Golden Gate. There are lights ahead, flashing dimly against the rising sun, and then ceasing altogether. Mile Rocks Lighthouse is to the south and Point Bonita Lighthouse to the north. Farther in is the white lighthouse at Point Diabolo. But here is the new Golden Gate Bridge, and the journey's end; Alcatraz light is out there on the port bow, and to the starboard is the waterfront of San Francisco.

Maneuvers of the same character are constantly being worked out by navigators on all parts of the coasts and on the Great Lakes. It is the work of the Lighthouse Service to establish and maintain the lighthouses, lightships, buoys, beacons, and day marks necessary for the safe and expeditious movement of ships. There are in use today more than 22,000 of these aids to navigation, ranging all the way from the powerful coastwise lights, offshore lightships, and radiobeacons, to the unattended lights of very small candlepower which mark the smaller rivers.

LIGHTHOUSES: VARIED TYPES AND CHARACTERISTICS

There are lighthouses of many different types upon our coasts, their outward appearance varying with the character of the land and with the relative importance of the light. Upon the Atlantic coast, where the land is, as a rule, comparatively low, are many tall towers, some of them nearly 200 feet in height. In the north, these towers are mostly of stone, the building materials coming from no great distance. In the Middle Atlantic States and in the south, where building stone is less frequently found, brick has been used in the construction. There are also many towers, particularly in the south, of skeleton iron construction, this type having the advantage of offering less resistance to hurricanes.

On the Pacific coast, which is generally bold and high, a low tower erected upon a prominent headland frequently serves the mariner in exactly the same manner as the taller towers of the Atlantic coast. Lighthouses which were built in early years on the Great Lakes were mostly masonry towers or structures of wood, but those of recent construction, particularly where they stand on submarine foundations, have been of steel and concrete.

In the early years of lighthouse work there were constructed many lighthouses which became famous, some for the engineering skill displayed in their erection, and others because of the extremely dangerous points which they marked. In 1791 the old tower at Cape Henry, Va., was built, a tower which has stood to the present day. Portland Head, Maine, is another of the early lighthouses which has become familiar to thousands, sparkling white against a darker background of rocky coast. Cape Hatteras Lighthouse marks one of the danger spots of the Atlantic coast, and is the tallest tower in the Service, being 193 feet high. Tybee, at the entrance to the Savannah River, the now leaning tower at Cape Romain, S.C., and the unused but still picturesque tower of Cape Florida are among the southern lighthouses which have added to the history of the Service.

Minots Ledge Lighthouse, off the Massachusetts coast, is known for the engineering difficulties involved, and for the tragedy occurring when the first structure at this point was destroyed by storm. Navesink Lighthouse, a fortress-like structure upon the Highlands of New Jersey, sends out a beam of 9,000,000 candlepower, the most powerful of all United States lights. In Florida, Jupiter Inlet Lighthouse is well known, and along the Florida Reefs are several noted structures, among them Fowey Rocks, American Shoals, and Alligator Reef.

Miah Maull Shoal Lighthouse, Delaware Bay.

On the Pacific coast Tillamook Rock and St. Georges Reef stand out because of the spectacular conditions under which the keepers must reach their stations. Cape Flattery, Point Reyes, and Point Loma have long been connected with the history of the coast, and Farallon is remembered by many, standing high on a pinnacle-like rock.

The flashing characteristics and their variations in color are of interest to every observer, and have been so planned that mariners will have a definite means of identifying each light.

LIGHTSHIPS

The outermost marks along the ocean coasts and at danger points on the Great Lakes are the lightships, some of them moored 15 miles or more offshore. These are in reality floating lighthouses, being equipped with masthead lights, powerful fog signals, and many of them also with radiobeacons. They are established at points where it is impracticable to build lighthouses, usually because of the depth of water. Lightships have an advantage possessed by few shore stations, for, as they are moored in deep water, vessels may steer

directly for them and pass them close to. This is particularly valuable in time of fog, for it enables mariners to fix their position with certainty.

Most of the 35 lightship stations mark the approaches to important harbors or rivers, and others mark dangerous shoals and reefs. A crew of 15 is required to man the larger lightships. All the newer vessels are self-propelling, carry fuel enough to remain on station for a year, and are designed to withstand the heaviest storms.

"Overfalls" Lightship, Delaware Bay Approach.

Of the lightships, those best known to travelers include Nantucket, Ambrose, Barnegat, Diamond Shoals; and, on the Pacific coast, San Francisco, Umatilla Reef, Blunts Reef, and Columbia River.

RADIOBEACONS

Radiobeacons are installed at lighthouses and on lightships, sending out radio signals in all directions for the guidance of ships. Vessels equipped with radio-compasses may intercept these signals, and from them determine the direction in which the sending station lies. Each lighthouse or lightship radiobeacon broadcasts a distinctive dot-and-dash signal so that it may readily be identified, and the reception of signals from two or more stations provides a cross bearing accurately establishing the receiving vessel's position. Radiobeacons have greatly increased the effectiveness of lighthouses and lightships, for they may be heard many miles away when the sending station lies below the horizon or is invisible because of fog, rain, or snow. There are more than 100 of these radiobeacons now in operation, having ranges of from 10 to 300 miles, and covering the entire coasts of the United States and the Great Lakes.

RIVER LIGHTS

On the Mississippi and tributary rivers there is an extensive system of lights. These are mostly of simple construction because of the constantly changing river banks, but are so placed as to show the general shapes of the river bends and the crossings. They are ordinarily attended by persons living in the vicinity, engaged as lamplighters, in many cases a group of several lights being in charge of the same attendant. Within the past few years a number of automatic electric lights have been installed along the rivers, their flashing characteristics being of particular value where they are viewed against a background of shore lights.

These lights serve a large volume of traffic, since the Mississippi River and its tributaries form a transportation network reaching numerous inland States and furnishing them with an outlet to the sea. The most recent additions to this lighting system have been made in connection with the opening of the water route from the Great Lakes to the Gulf of Mexico.

AUTOMATIC LIGHTS

Automatic lights of many types are in service throughout the country, providing navigational facilities in many of the secondary channels, and supplementing, along the coasts, the larger attended lighthouses. Automatic lights in considerable numbers are to be found in such waterways as the Hudson River, the Delaware River, Chesapeake Bay and its tributaries, the sounds of North Carolina, the Houston Channel, the Columbia River, and the extensive inland waters of Alaska. The principal types of automatic light are those operated either by acetylene gas or electricity. Lights operated by acetylene gas in small containers and under pressure will burn without attention for as long as 6 months. Electric lights, deriving current from self-contained primary cells, are used in many cases where a light of low candlepower is sufficient. About 45 percent of all coast and lake lights are now operated automatically.

BUOYS

Buoys now occupy a very important place in the system of aids to navigation. They were not so important in the early days of lighthouse work, when sailing vessels were guided mainly by the lighthouses built on headlands and at harbor entrances. But in the last half century buoys have been increasingly depended upon. This change is due to the increased speed of vessels and the importance of their following the shortest routes or narrow-dredged channels, and the fact that buoys furnish the ready means of marking these channels. Buoys have the great advantage that they may be moored close to the track of vessels, so as to mark both sides of a channel. They are also used to mark turning points, obstructions, anchorage grounds, and isolated dangers. They are anchored in position and cared for by the lighthouse tenders, which are provided with special lifting apparatus for handling them. Buoys weigh from 350 pounds to 12 tons or more. Many of them are lighted and may be provided also with whistles or

bells. Lighted buoys are capable of functioning for several months without attention. They are, however, susceptible to many accidents, and constant attention is necessary to keep them efficient. Various types of buoys are constructed, some suited only for use in sheltered waters, while others are able to withstand the battering of the open sea. Under favorable conditions, their lights are visible up to about 10 miles, and their sound signals may be heard for 2 or 3 miles.

ORGANIZATION OF SERVICE

The executive offices of the Lighthouse Service are in Washington, headed by the Commissioner of Lighthouses. Under this officer are the offices of the Chief Engineer, the Divisions of Architectural and Marine Engineering, the Hydrographic Division, and the various administrative sections of the Bureau. The field service is divided into 17 districts, each in charge of a superintendent of lighthouses having an office at some important seaport in the district. At each district headquarters there is a technical staff for the construction and maintenance of both land stations and floating equipment, as well as a clerical force. Each district has one or more lighthouse tenders for the purpose of delivering supplies to lighthouses and lightships, for transporting men and materials on construction and repair work, and for maintaining the buoyage system. At least one lighthouse depot is situated in each district, and used as the base for storage and distribution of supplies and apparatus. The depots usually have facilities for construction and repair work.

HISTORY

The work of the Lighthouse Service is one of the oldest of Government activities, being provided for in one of the first acts of Congress, adopted in 1789. The first lighthouse in America was that erected on an island in Boston Harbor in 1716, and it is still in service. Other lighthouses were erected or planned by the Colonial Governments, and in 1789, upon the formation of the Federal Government, 10 lighthouses were transferred to it. These lights were all on the Atlantic coast, the farthest south being at Charleston Harbor, S.C. During the next 50 years about 170 lighthouses were erected and 3 lightships placed on stations. The extension of trade westward via the Great Lakes brought a call for lighthouses from a new quarter, and in 1819 the first light was built on these inland waters at Presque Isle, Pa., on Lake Erie. At the time of the gold rush to California in 1849 there was not a single light on the Pacific coast to aid mariners, but in 1854 a light was established at Alcatraz, just within the Golden Gate, and several lights were built in the following year. The growth of the Lighthouse Service has followed the expansion of the country, until today navigational aids are maintained on all parts of the Atlantic and Pacific coasts, the Great Lakes, Puerto Rico, Alaska, the Hawaiian Islands and the approaches to the Panama Canal.

BUREAU OF MARINE INSPECTION AND NAVIGATION

JOSEPH B. WEAVER, Director

By way of historical retrospect, it will be recalled that the establishment of proper safeguards for the protection of our domestic and foreign water-borne commerce received the attention of the first Congress of the United States.

When piracy, shanghaiing, and mutiny were common events in seafaring history, those who went down to sea in ships led an existence which may be characterized as romantic, but which admittedly was far from being either a secure or a settled life.

A voyage undertaken without the aids to navigation such as have been provided by the Federal Government in recent times necessarily made it a venture filled with uncertainty and speculation.

A lack of inspection laws or established rules of navigation contributed to the dangers from fire, explosion, or collision. Ships were permitted to go to sea in unseaworthy condition or without adequate life-preserving apparatus on board for the protection of passengers and crew in case of emergency. In many instances, there was added the hazard of incompetent officers and crew.

In the early days of our country, shipping and shipbuilding were paramount home industries and it was natural for public attention to be centered upon them. So it was only a few years after the birth of the United States that laws were drafted looking to the welfare of American ships and seamen.

These first rules and regulations have since been enlarged and revised into a body of law intended primarily to foster and promote safety of life and property incident to water commerce.

This body of law was administered originally by various governmental agencies. But with the increasing magnitude of the task due to the advent of steam as a means of propulsion of vessels following Robert Fulton's successful demonstration in 1807, Congress established the Steamboat Inspection Service in 1838 as a distinct inspection agency. The act of Congress creating the Steamboat Inspection Service was enacted primarily to protect the lives of passengers from boiler explosions on steam vessels, a very common occurrence during this particular period. In 1884, the Bureau of Navigation was created, and by the organic act of February 14, 1903, creating the Department of Commerce as an executive branch of the Federal Government, provision was made for the transfer of both the Bureau of Navigation and the Steamboat Inspection Service to this Department.

These two Bureaus continued, however, to function each within its own prescribed sphere of activity until 1932 when they were combined as the Bureau of Navigation and Steamboat Inspection, an action taken to promote a closer coordination of interrelated work in the two Bureaus. At the second session of the Seventy-fourth Congress, legislation was enacted changing the name to the "Bureau of Marine Inspection and Navigation", and greatly broadening its powers with regard to investigations and trials covering marine casualties.

In the consolidation of these two agencies, a special reorganization along functional lines has just been effected that will have the result of greater executive efficiency, at the same time making it possible to render greatly improved service to the public commensurate with its needs.

The far-reaching scope of the activities of the Bureau as presently constituted, include the administration of the provisions of those laws having for their purpose the increased safety of almost every type of American vessel engaged in commercial pursuits, from the smallest motor boat carrying one spectator at a college regatta to the mammoth ocean liner.

From the moment the keel of a new ship is laid, until after her weather-beaten hull is sold for junk, or let slip to a watery grave in Davy Jones' Locker, this Bureau follows that vessel's career—testing, inspecting, registering, examining, and safeguarding.

Let us trace the records which the Bureau keeps of the life of a typical American passenger ship of today, and observe the untiring zeal with which this Bureau discharges its responsibility for the efficient water transportation of the potential traveler.

Before ever the new ship is built, the active interest of the Bureau in her welfare begins. Blue prints of plans for the construction of the vessel are submitted to the corps of technical men of the Bureau who check over the plans to ascertain whether or not they conform in every respect to all the requirements prescribed by the Bureau as to hull, boilers, equipment, etc. The design of the boilers to be used must be approved by the Bureau, and all material entering into their construction subjected to tests at the place of manufacture by the Bureau's representatives in order to be assured that the material is of the highest quality. The actual construction of the boilers is given close supervision in the shop as well as after installation.

In the case of welded boilers, now being used extensively, the Bureau insists upon practical tests to determine whether the welding operators are competent to make sound welds. The work is supervised carefully by the Bureau's representatives and X-ray pictures are taken of the welded joints in order to ascertain whether or not the welds are sound. Examination of the films is made with a special instrument and these films are made a part of the permanent record of the boilers.

Before boilers are used, they are subjected to a hydrostatic test equal to one and one-half times the working pressure at which the boiler will be permitted to operate.

The same careful procedure applies to piping, appurtenances, and equipment pertaining to the power plant. The main engine shafting is also tested.

Before the ship is launched, an inspection often requiring several days is undertaken. An inspector of hulls and an inspector of boilers clamber through bottom tanks and inside of the boilers inspecting materials and construction. A special test is made of the ship's stability, involving weight placements and complicated calculations. Every lifeboat is inspected to see that its construction conforms to the specifications laid down, and that it contains the score or more requisite supplies and equipment. The fire-fighting and life-saving apparatus, the lighting installations, the entire propelling machinery, the steering engine, and the signal gear are thoroughly examined.

Upon completion of the vessel, a trial trip inspection with Bureau inspectors aboard to observe the vessel carefully under actual operating conditions is required before the vessel is permitted to be placed in service.

The Bureau is responsible for the "Admeasurement" of all vessels; that is, the making of certain calculations to determine the gross and net tonnage of the vessel. This factor is of utmost significance since it is thereafter used as a yardstick in the collection of tonnage taxes and other fees throughout the life of the vessel.

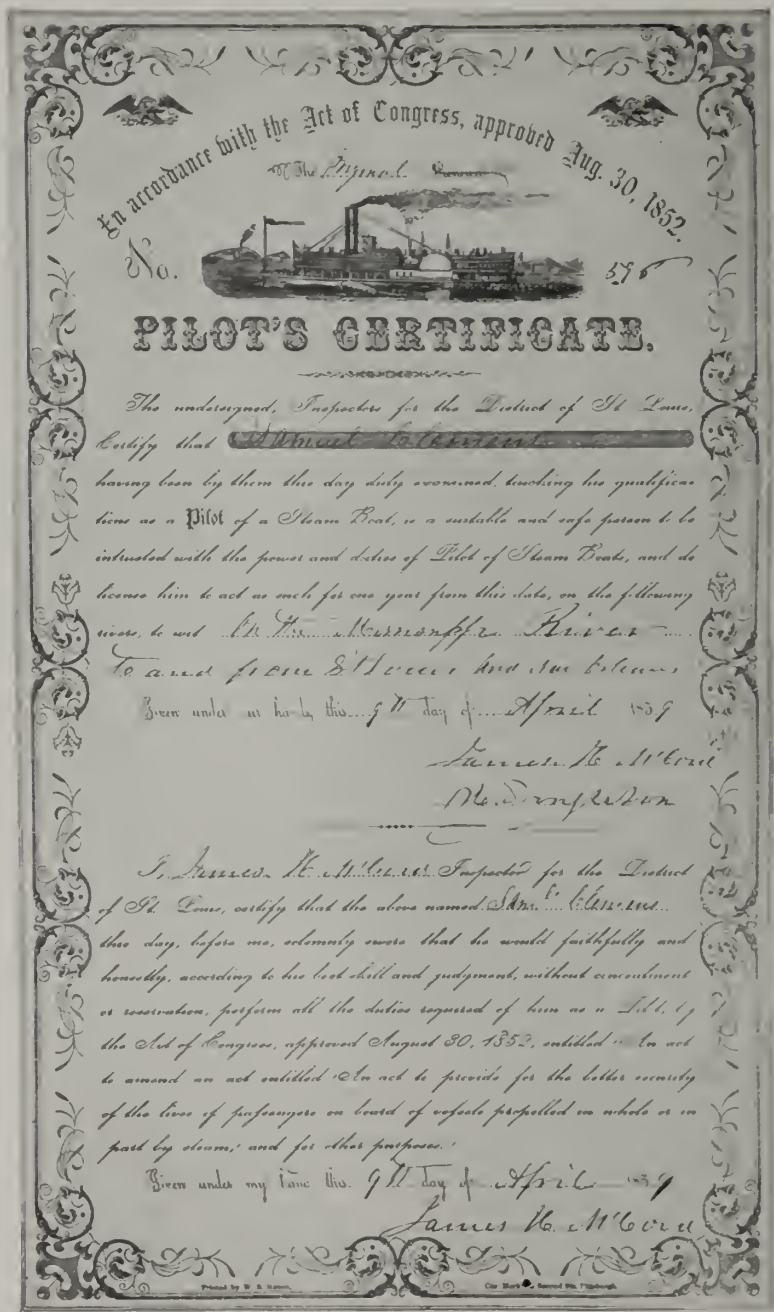
To prevent overloading of the vessel, a mark is placed upon the sides amidships indicating the water line below which it may not be submerged in loading. This mark is determined by the application of rules first agreed upon by an international conference of maritime experts and later incorporated in regulations of the Department of Commerce.

When all these steps are completed, the vessel is ready to be documented under the American flag. This process involves filing the necessary application supported by pertinent data required, and the authorization to engage in foreign or coastwise trade or commercial fisheries.

Marine documents are divided into three classes—namely, registers, enrollments, and licenses. All vessels to be placed in the foreign trade are required to be documented under a register. Vessels over 20 net tons to be engaged in the coastwise trade or commercial fisheries touching ports of the United States are required to operate under an enrollment and license, but for vessels under 20 net tons register, a license only is required.

For the protection of our domestic commerce, only vessels owned by American citizens are permitted to engage in the coastwise trade and with certain exceptions the vessels shall have been built in the United States.

Next, we are to consider perhaps the most important safety factor—a proper crew to man the ship. The human element contributes to many of our marine disasters and should, therefore, be carefully considered. Sufficient licensed personnel, having previously satisfied the Bureau as to their qualifications by passing strict examinations, must be provided. It is the responsibility of the Bureau to see that an adequate crew both as to number and qualifications is provided to insure the safe operation of the ship.



In accordance with the Act of Congress, approved Aug. 30, 1852.

The Original

No. 576

PILOT'S CERTIFICATE.

The undersigned, Inspectors for the District of St. Louis, certify that [redacted] having been by them this day duly examined, touching his qualifications as a Pilot of a Steam Boat, is a suitable and safe person to be intrusted with the power and duties of Pilot of Steam Boats, and do license him to act as such for one year from this date, on the following rivers, to wit: the Mississippi River from St. Louis to New Orleans.

Given under our hands this 9th day of April 1859

James H. M'Cord

M. Singleton

I, James H. M'Cord, Inspector for the District of St. Louis, certify that the above named [redacted] this day, before me, solemnly swore that he would faithfully and honestly, according to his best skill and judgment, without concealment or reservation, perform all the duties required of him as a Pilot, by the Act of Congress, approved August 30, 1852, entitled "An act to amend an act entitled 'An act to provide for the better security of the lives of passengers on board of vessels propelled in whole or in part by steam,' and for other purposes."

Given under my hand this 9th day of April 1859

James H. M'Cord

Facsimile of Mark Twain's First Pilot Certificate.

This certificate was issued to him in 1859 by the Steamboat Inspection Service. It permitted him to pilot steamboats on the Mississippi River between St. Louis and New Orleans.

Before leaving and on arrival at any American port, the many regulations of the Bureau pertaining to manifests of cargo, clearances, fees, taxes, and employment contracts are observed, and the necessary transactions relating to them are completed. If the vessel is sold, mortgaged, or transferred from foreign trade, let us say, to the coastwise service, a new set of requirements are enforced with the offices of the Bureau serving as the combined focus of operations, information service, legal repository, court of law, and statistical nerve center for navigation in the United States.

Besides these functions, which pertain to every commercial vessel of American registry, the Bureau is concerned with enforcing and compiling the regulations governing traffic in the St. Marys River, which carriers a greater annual tonnage than either the Panama or the Suez Canals. The Bureau also supervises and patrols the many regattas which take place each year along our coasts. More

U.S.M.V. "Siwash."

One of the Bureau's inspection vessels which covers the New York and New England waters, enforcing the navigation laws. She carries two fast inspection tenders, with the help of which she is engaged constantly in the inspection of approximately 79,000 motorboats, for compliance with the numbering act and the navigation laws involving proper manning and life-saving equipment.

than 300,000 small motor craft also come under the jurisdiction of the Bureau, which, by means of 6 inspection vessels on the Great Lakes, the Atlantic and Gulf coasts, enforces the law requiring the registration of such craft and the installation of life-saving equipment, and obedience to the principles of navigation.

An added service both to the seaman and the shipowner is provided by the shipping commissioners acting under the direction of the Bureau.

At 14 of the principal seaports, the shipping commissioners administer the voluminous laws for the protection of our seamen and the maintenance of discipline on shipboard. They supervise the contract of employment of the seamen, see that they are paid their wages, have proper food and quarters, and,

should they die on the voyage, see that their wages and effects go to their next of kin. The shipping commissioner arbitrates disputes which arise during the voyage, his decision being final as to the facts. This arbitration is available without delay or cost to the seamen.

In addition, at 12 of the ports where shipping commissioners are stationed, a shipping service is maintained acting as an employment agency for the purpose of securing seafaring personnel for all ships of American registry. It attends to the physical examination and general welfare of the seamen and promotes Americanization of crews.

The jurisdiction of the Bureau does not end with sailing of the ship on her maiden voyage. There is a continuing responsibility to assure that proper safeguards are maintained. Each ship must undergo a very rigorous inspection annually to make sure that the vessel is maintained in proper seaworthy condition, and equipped with the latest safety devices; also, intermediate inspections are frequently made.

Every officer's promotion as he progressively climbs the ladder from third mate to master, or from third assistant engineer to chief engineer is accomlished by examinations before officers of the Bureau. Every new mechanical installation of importance, every overhauling, drydocking, or major change in the vessel's equipment or construction is examined and checked before it goes into effect. And in addition, at specified intervals an inspection, no less rigorous because of its regularity, is carried out from stem to stern.

Another important phase of the Bureau's activity is the investigations and trials incident to marine casualties. The power to make a searching inquiry to determine the cause of marine casualties enables the Bureau to take the necessary corrective steps to prevent recurrences.

In connection with the more serious marine accidents involving vessels of the United States, a Board comprised of a representative of this Bureau, of the United States Coast Guard, and the Department of Justice investigates and prepares written reports of its findings, the main objective of this Board being to determine whether incompetence, misconduct, negligence, or willful violation of law on the part of the ship's personnel or a failure due to design or structural deficiencies contributed to the accident.

In connection with marine accidents of a less serious nature not involving the loss of life, a board comprised of a Supervising Inspector and two Principal Traveling Inspectors conducts a similar investigation and renders a report.

If as a result of investigation by these Boards it is found that there is substantial evidence of misconduct or negligence on the part of a member of the ship's personnel, such member is cited for formal trial, at which he is confronted with specific charges and permitted to appear with or without counsel to answer the charges. The findings of the Board are then submitted to the Director for final decision. Provided the charges are sustained, the Director is empowered to suspend or revoke his license.

A right of appeal from the decision of the Director may be made to the Secretary whose decision is final.

The revocation or suspension of licenses as a result of these trials is intended as disciplinary rather than punitive, and the influence exerted by this authority wisely exercised cannot be overestimated in its contribution to ship discipline and the reduction of accidents.

The life of an inspector in the service is one of constant duty and ever present danger, and subject to occupational hazards. Boilers failing under hydrostatic tests, freezing showers from bursting fire hose, crippling oil fumes from faulty ventilation, are some of the contingencies to be expected. More than one inspector has had uncomfortable moments in the bottom of a ship on his annual round. One luckless expert was imprisoned in a boiler when a careless engineer replaced the manhole cover; another escaped death by a hair's breadth when he was caught in the chain locker as the anchor was suddenly lowered and the huge links of the chain were converted from inanimate pieces of steel into a writhing, body-crushing monster.

In the foregoing, an endeavor has been made to furnish a broad general picture of the public relations of this Bureau in connection with and the discharge of the duties by the local offices of the Bureau located at the various ports throughout the United States. The planning and direction of the entire Bureau is, of course, centralized in the office in Washington, D. C., in charge of the Director, who with a staff of technical assistants and a small group of administrative personnel is directly responsible for promulgating various rules and regulations within the bounds of statutory authority vested in the Bureau by Congress.

In spite of the fact that Congress has legislated rather freely on this important subject during the past hundred years, the corresponding advance in the shipping and shipbuilding industry has given rise to an urgent need for still additional legislation to meet the public demand for increased safety and improved conditions in connection with ship personnel.

Since this Bureau is authorized to promulgate and enforce regulations only within the statutory limitations laid down by Congress, it naturally follows that recommendations based upon the Bureau's experience and careful studies must be made from time to time to the Secretary of Commerce for the consideration of Congress.

In conclusion, mention should be made that while the service rendered by this Bureau is far-reaching, it is being maintained on a self-supporting basis, as shown by revenue received by the Treasury, produced by the collection of tonnage taxes, navigation fees, and fines, substantially exceeding the amount appropriated by the Congress to carry on this important work.

PATENT OFFICE

CONWAY P. COE, Commissioner

Human beings in every quarter of the globe—even the denizens of lands uncivilized—are brought daily under the spell of America's inventive genius. However unaware these myriad millions may be of this American influence on their lives, their experiences and perhaps their very destinies, they are nevertheless more and more numerously its beneficiaries.

It would be difficult, for example, to find anywhere in the world a people unfamiliar with the automobile. Steamboats, big and little, have long coursed the rivers of every clime. Airplanes have circled the earth and crisscrossed the continents. And these three—motor cars, steamboats, and planes—are all American inventions. Indeed, there is no tribe so remote or barbarous but has formed some vital acquaintance with the handiwork of American inventors. Explorers, traders, missionaries have been the bearers of American inventions to these savage races in distant regions.

Even more profoundly and lastingly has America s inventiveness affected the civilized nations, east and west. Their industrial progress has depended almost as much as that of the United States on the discoveries and inventions contributed by Americans.

It is owing to the foresight of the builders of this Republic that the practical arts and sciences have advanced so rapidly and so far. All that has been done here and much that has been accomplished abroad in the creation and development of industry and commerce is attributable to the constitutional provision written in the last years of the eighteenth century, by which Congress is empowered "to promote the progress of science and of the useful arts by securing for limited times to * * * inventors the exclusive rights to their * * * discoveries."

SIGNIFICANCE AND VARIED CHARACTER OF PATENT OFFICE WORK

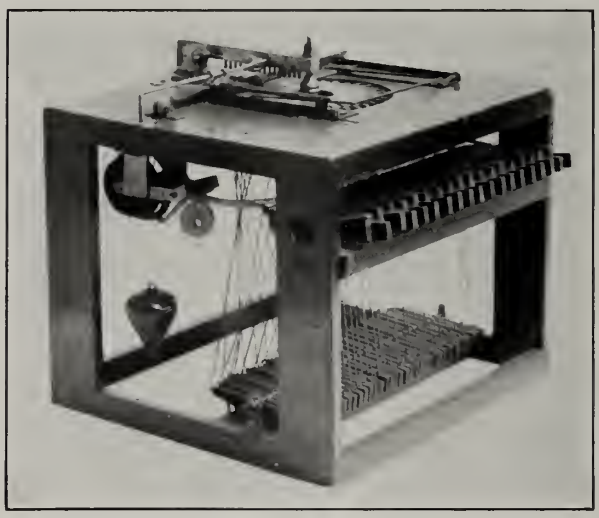
The Patent Office issues patents relating to everything made by man—from a clothespin to a complicated pattern weaving loom, from a buckle to a seemingly miraculous newspaper printing press that prints, folds, and even counts more than 50,000 papers in an hour.

For more than 125 years it has been the function of the Patent Office to secure to inventors the rights to their "brain children," while at the same time it has protected and furthered the public interest. To this function the Office has added the duty of registering trade marks, prints, and labels used on merchandise entering interstate and foreign commerce. In order to perform this work,

the Patent Office maintains 67 divisions for the examination of applications for mechanical patents, design patents and trade marks, prints, and labels. In the years of industrial prosperity the number of such applications averaged more than 100,000 annually. Since January 1, 1934, they have been filed at the rate of 62,000 a year.

SPECIAL TECHNICAL AND LEGAL STAFF

That the Office may deal effectively with so large a number of applications representing claims to invention in nearly every art—in almost every department of human activity— some 690 men and women of special technical training are employed as examiners. Besides these experts, certain auxiliary and appellate agencies of the Office concern themselves with the scientific and legal questions and problems involved in the issuance of some 50,000 patents every 12 months. The clerical and administrative divisions employ about 640 persons.



A Mechanical Typographer.

This machine (patented Aug. 29, 1871) was called by its inventor, C. Latham Sholes, of Milwaukee, Wis., a "mechanical typographer." It was one of the antecedents of the typewriters now in use throughout the world.

Striking, indeed, is the contrast afforded by this present staff with the conditions that prevailed a little more than a hundred years ago—when the entire force engaged in granting patents in the United States consisted of just *three persons!* But the growth has been natural—inevitable—because nowadays, in the course of a single year, there are as many patents granted as were granted in the entire period between the time when General Washington assumed the Presidency in 1789 and the time when the guns of Sumter ushered in the Civil War.

Though its task of investigating and determining the claims of inventors is highly scientific, the Patent Office is nevertheless a legal institution. Its findings and its proceedings are judicial. At the same time its professional personnel must be thoroughly grounded in the arts and sciences, and so organized that the thousands of applications for patents covering almost every conceivable appliance, article, or process may be considered and adjudged by specialists in the arts and sciences involved.

CHARACTER OF PATENT GRANT

A patent grant gives to the inventor the right to exclude others from making, using, or selling his invention for a term of 17 years. For that period it is a legal monopoly, and as such, and if it is important to industry, it significantly affects the public interest. The law, therefore, limits the life of the patent and requires that it shall fully disclose the invention it covers, so that after its expiration the product, device, or process may become common property of the public. Accordingly the application embraces a drawing, if the invention is one susceptible of illustration, a specification describing the nature and the operation of the invention, and the "claims" reciting the precise features or points of which the inventor believes himself to be the owner, thus determining the scope of the protection afforded by the patent grant.

TYPICAL PROCEDURE FOLLOWED

In brief, the following procedure is adopted in the examination of an application for patent: The examiner first satisfies himself that the invention sought to

Lincoln's Steamboat.

This model, supplied to the U.S. Patent Office by Abraham Lincoln, illustrates what he described as " a new and improved manner of combining adjustable buoyant air chambers with a steamboat or other vessel for the purpose of enabling draft of water to be readily lessened to enable them to pass over bars."

be patented is fully and clearly disclosed. He next searches through domestic and foreign patents and in the literature devoted to the art involved, so that he may determine what novel and original features appear in the application and the extent to which the inventor's claims should be restricted by reason of prior invention. In each division, the arts with which it deals are exhaustively classified and indexed, so that the examiners may readily be enabled to locate the most pertinent existing patents in any given classification. These searches or studies are of course necessary to prevent, so far as possible, the granting of invalid patents.

Applications are examined in the order in which they are filed. The examiner passes on the merits of each application referred to his division for action. He may, if the facts warrant, and after notice to the applicant, reject any or all of the claims advanced in the application. The examiner decides whether a patent shall issue, and determines the scope of protection to be afforded. His adverse decisions, however, are subject to appeal to the Board of Patent Appeals, a body within the Office, and from that tribunal appeals may be taken to the Court of Customs and Patent Appeals. Further relief from an adverse decision of the Patent Office may take the form of a suit in the Supreme Court of the District of Columbia against the Commissioner of Patents under section 4915, Revised Statutes.

TRADE-MARK DIVISION

Proceedings on applications for the registration of trade marks, prints, and labels are entirely separate from proceedings in patent cases, being governed by a special code of laws and regulations. The work is handled by the Trade-Mark Division, which receives and acts on all applications for trade-mark protection. All registered trade marks, prints, and labels are kept on file in the Trade-Mark Division, the trade marks being appropriately classified and indexed to facilitate search and examination.

INTERFERENCE DIVISION

The Interference Division decides questions of priority arising in both patent and trade-mark cases where two or more applicants contest for the same invention. The patent branch of the Division takes charge of interference proceedings when a priority issue is discovered in a mechanical or chemical examining division. The trade-mark branch has similar jurisdiction in contested trade-mark cases.

From the final decision entered by the interference examiner in patent cases, appeal may be taken to the Board of Patent Appeals. In trade-mark cases, appeal may be taken directly to the Commissioner of Patents.

BOARD OF PATENT APPEALS

The Board of Appeals consists of the Commissioner of Patents, the First Assistant Commissioner, the Assistant Commissioners, and nine examiners-in-chief, all of whom are appointed by the President. Three members of this Board may hear and decide appeals. Adverse decisions of the examining divisions and of the interference examiner on applications for patents are appealable to this Board. The proceedings are formal and conclude with a written decision over the signature of the members of the Board, sustaining, reversing, or modifying the decision of the examiner. As before stated, from this Board appeal lies to the United States Court of Customs and Patent Appeals, or applicants may file a bill in equity under section 4915, Revised Statutes.

This statute provides that whenever a patent or application is refused by the Commissioner of Patents, the applicant may have remedy by bill in equity, if filed within 6 months after such refusal, unless appeal has been taken from the decision of the Board of Patent Appeals to the United States Court of Customs and Patent Appeals, and such appeal is pending or has been decided, in which

case no action may be brought under this section. The court having cognizance of such action, after notice to adverse parties and other due proceedings, may adjudge that such applicant is entitled, according to law, to receive a patent for his invention, as specified in his claim, or for any part thereof, as the facts in the case may appear.

COMMISSIONER OF PATENTS

In addition to exercising a general administrative supervision over the Patent Office, the Commissioner of Patents performs important judicial functions. His judicial duties are shared with the three Assistant Commissioners, whose decisions, although rendered in their own names, have the same force as those of the Commissioner. Decisions on applications for the registration of trade marks, prints, or labels may be appealed from the trade-mark examiner, or the examiner of trade-mark interferences, to the Commissioner. The Commissioner, with the three Assistant Commissioners and the nine examiners-in-chief, constitute a Board of Patent Appeals already mentioned.

SOLICITOR AND LAW EXAMINER

The Solicitor is the Commissioner's chief law officer. He appears for the Commissioner in cases heard before the Court of Customs and Patent Appeals and represents him in suits to which he is a party in his official capacity. There are three law examiners, who aid the Commissioner, the Assistant Commissioners, and the Solicitor generally in the performance of their legal and judicial duties and advise them in particular cases. They examine authorities and assist in preparing the formal decisions reached in appealed cases.

FUNCTIONS OF OTHER DIVISIONS

The Mails and Files Division receives, records, and distributes the mail.

The Financial Division receives and accounts for fees, sells coupons receivable in payment for copies of patents and for other minor services desired by applicants or attorneys, and keeps the appropriation and money accounts of the Patent Office. The following schedule shows the principal fees now applicable:

SCHEDULE OF FEES

Application fee, mechanical patent, $30, plus $1 additional for every claim over 20.
Application fees, design patent, $10–$15–$30.
Application fee, trade marks, $15.
Application fee, labels and prints, $6.
Issue fee, after approval of application, $30, plus $1 additional for every claim over 20.
Application for reissue of patent, $30.
Disclaimer fee, $10.
Petition to revive an abandoned application, $10.
Appeal fees, $15–$25.
Copies of patents, 10 cents each.
For certified copy of patent, including grant, if in print, $1.10.
Manuscript copies of records, for every 100 words or fraction thereof, 10 cents.
If certified, for the certificate additional, 50 cents.
Recording fees (assignments), $3 and up.
Abstracts of title, $3 and up.
Title searches, per hour, $1.50.

The Application Division inspects all applications for patents as they are received, to see that they are complete and in due form, prepares them for attention by the examining divisions, distributes them to those divisions, and conducts necessary correspondence with applicants regarding matters of form.

The Issue and Gazette Division acts as the publication agency of the Patent Office, preparing the specifications and drawings of patents for printing. It issues about 1,200 weekly, and publishes them in the Official Gazette, a weekly publication of the Patent Office. The sale, and in certain cases free distribution, of copies of patents and trade-mark certificates are in charge of the Publications Division, which keeps copies in stock of all existing patents and trade marks—more than 2,000,000 in number.

Copies of official papers, including patents, trade marks, applications, and other records which may be requested by attorneys and applicants for use in litigation or preparation of applications, are furnished by the Manuscript Division. The Drafting Division has as its function the inspection of the drawings which accompany applications for mechanical and design patents, and at the request of the applicant and for a reasonable fee, the Division alters and corrects certain drawings to secure conformity with the office rules or the requirements of the examiners.

The Assignment Division receives and records all deeds or assignments transferring property rights in patents, trade marks, or applications. Instruments affecting titles to patents are constantly being received, recorded, and returned to the owner. For a moderate fee, the records are searched and abstracts of title furnished. Before any patent or trade-mark certificate is issued, careful determination is always made to insure that the documents shall be issued to the recorded owner.

SCIENTIFIC LIBRARY—SEARCH ROOM

Complete sets of foreign patents, some 3,000,000 in number, are to be found in the Scientific Library, which is used by examiners and also by the public. It contains thousands of volumes of technical and scientific periodicals and books in various languages. The Search Room contains copies of all United States patents and trade marks, arranged in classified order and conveniently indexed. It is primarily for the use of inventors and attorneys, but it is also open to the public generally.

It is interesting to note that for many years the annual revenue accruing to the Patent Office in the course of its activities has been sufficient to defray a large percentage of the expense incurred in the operation of this large and complex organization.

UNITED STATES SHIPPING BOARD BUREAU[1]

J. C. PEACOCK, Director.

During the first half of the nineteenth century, a great tradition of the sea was in the making. The commercial and shipping supremacy of foreign countries was being challenged by the rapidly growing young nation of the West, whose products and flag were being carried into foreign ports by American clipper ships, which were winning a well-earned recognition throughout the seven seas for their speed and seaworthiness. These new vessels, of radical design, at first lightly regarded by the older maritime nations, soon proved to be formidable competitors and played an essential part in establishing a new and flourishing era of American foreign trade. The *Flying Cloud*, *Lightning*, *Rainbow*, *Sovereign of the Seas*, *Glory of the Seas*, and other ships with their high masts and curved bows, were adding new pages to the history of world shipbuilding, trade, and seamanship. These names, now almost legendary, and the exploits of the officers and crews who manned them, established a proud record in the annals of American commercial development which is still undimmed by the passing years.

The westward march of American development from the middle of the nineteenth century marked the passing of the American clipper ship and a gradual decline in the importance of the American merchant marine. The possibilities and resources of agriculture and commerce on the expanding Western frontier tended to divert American interest from shipping and foreign trade. Contributing to the decline of the merchant marine was also the Civil War (during which many vessels were transferred from American to foreign registry) as well as the rapid progress which foreign nations, notably England, were making in the construction of steam-propelled, iron ships.

From 1850, therefore, and well into the early years of the twentieth century, the problems of internal development forced into the background the importance of the American merchant marine which, in peace or in war, would enable the Nation to carry on its trade and other relations with foreign countries. For these many years it was forgotten by the great majority of American people that it is dangerous to depend upon other nations to provide this means of maritime transportation and communication. This fact, with the realization that no nation of the first rank is without its own merchant marine, was sharply brought to the attention of the American people upon the declaration of war in Europe in August 1914.

Soon after the outbreak of the war, headlines in American newspapers told graphic stories about American tourists being stranded abroad at ports of embarkation because of the lack of ships and about the difficulty of supplying

[1] On the date of organization of a new agency, to be known as the U. S. Maritime Commission, created by Public Act No. 835, Seventy-fourth Congress, approved June 29, 1936, the U. S. Shipping Board Bureau will be transferred to that Commission and will cease to be a unit of the Department of Commerce.

the greatly increased demands of European countries for American products, for the same reason. Again, after an interval of more than 60 years, the minds of the American people turned to the sea and groped in bewilderment for a solution of the pressing problems.

With the first rumbles of war, every nation directly involved immediately withdrew many of its ships from ordinary service for the more important task of transporting its army and war munitions, as well as huge supplies of food and clothing required by both its civilian and military population. The United States, with a pitiably small number (only 85 vessels) engaged in regular foreign-trade service, was virtually water-bound. Almost overnight, the American

The Clipper Ship "Lightning."

Symbol of American Maritime Prowess in the Eighteen Fifties.

people became conscious of the vital necessity of an American merchant marine, and throughout the country went up the cry for more ships.

SITUATION DURING AND AFTER WORLD WAR

Although American foreign commerce had shown consistent gains for some years prior to 1914, these were comparatively small in contrast to the tremendous flood of orders for American products which followed the declaration of war. Shipments of every description began piling up at piers and wharves all over the United States. Vast amounts of grain were stored up all over the country in elevators because we were unable to find ships in which to send it abroad, where it was urgently needed. The same condition existed throughout the South with respect to cotton; the famous slogan, "Buy a bale of cotton," was created in an attempt to relieve the situation. It soon became inevitable

that, because of the absence of adequate private financial resources to deal with the situation, the U.S. Government itself would have to assume the major part in the gigantic undertaking of building the hundreds of ships required to carry this merchandise abroad.

The answer was the Shipping Act of 1916, which created the United States Shipping Board—designed to administer and control the American shipping industry—and the United States Shipping Board Emergency Fleet Corporation (the name of which was changed in 1928 to the Merchant Fleet Corporation), which was authorized to build and operate ships. This program had scarcely got under way when the need of a merchant marine was again sharply emphasized by the declaration of war between the United States and Germany. Before that time, the emergency had resulted from commercial reasons; now the most vital interests of the Nation were involved and the shipping question became a war-time problem.

The activities of the United States Shipping Board at this time were increased tenfold. Never in the history of the world had any nation embarked upon such an extensive shipbuilding program. In a comparatively short time, hundreds of ships were launched from shipyards all over the United States. These ships were necessary to maintain our troops on the Western Front, as well as to transport provisions for our Navy in European waters. They were also an important factor in opposing the attempts of the enemy to wipe ships of commerce from the sea. The history of commercial shipping during the World War proved again the well-known fact that the Navy and the merchant marine together constitute the "floating power" of the United States and that a Navy without an adequate naval auxiliary in the form of merchant ships is a Navy in name only.

After the armistice in November 1918, the United States Shipping Board-Emergency Fleet Corporation fleet continued to carry thousands of tons of food and supplies to the impoverished and exhausted nations of Europe—to former enemies as well as allies. In this great humanitarian effort the war-time merchant fleet contributed materially to the success of the vast relief programs which were organized to feed destitute millions abroad.

LEGISLATION AND EXECUTIVE ACTION

By the latter part of 1921, with the last phase of its shipbuilding program completed, the United States Shipping Board speeded up liquidating activities which had already been going on for several months. The Merchant Marine Act of 1920 instructed the Board to dispose of its vessels as rapidly as possible to private interests and thereby remove the Government from the actual operation of ships in competition with private ship operators. Under this mandate of Congress, hundreds of passenger and cargo vessels were transferred to private ownership. The Merchant Marine Act of 1920 also gave the Shipping Board even broader powers than had been granted in the original act of 1916—including additional powers of regulation. Under the Merchant Marine Act, the Shipping Board was instructed to be instrumental in assisting the American

merchant marine to adjust itself to a peace-time basis and in establishing essential trade services which, so far as foreign trade was concerned, with few exceptions, did not exist prior to 1916. The act of 1920 also created the Construction Loan Fund from which financial assistance could be provided to ship operators for the construction of new vessels of the latest approved design so that American companies might compete favorably with the merchant marines of foreign nations which were again making a serious bid for American cargo and passengers. In 1928, Congress passed another Merchant Marine Act which, among other things, increased the Construction Loan Fund and established a system of providing financial assistance to ship operators in the form of ocean-mail contracts. The latter provision was the first positive action of Congress after the World War to subsidize private American shipping through the grant of public funds for the operation of vessels.

The need of such assistance to ship operators was accentuated by the world economic depression, which has caused practically every nation maintaining a

A Fleet Cabin Liner of the American Merchant Marine of Today.

merchant marine to provide assistance, in some form, to its shipping industry. It has been recognized that without this governmental assistance shipping lines would have to be withdrawn from service and important trade routes abandoned.

In the case of the American merchant marine there was an additional cause for Government assistance, namely, the need to offset the disadvantage which confronts the American ship operator through the higher cost of constructing ships in the United States and other factors which elevate the cost of American ship operation to a level considerably higher than that of the ship operators of foreign countries. It was to equalize this differential, and to place American shipping on a basis fairly competitive with foreign countries, that a subsidy in the form of mail contracts was provided in the Merchant Marine Act of 1928. The same problem is receiving the most careful consideration of the U.S. Government today.

By Executive order of June 10, 1933, President Roosevelt transferred the functions of the former United States Shipping Board (including those with

respect to the United States Shipping Board Merchant Fleet Corporation) to the Secretary of Commerce. The United States Shipping Board Bureau, organized within the Department of Commerce as a result of this transfer, is charged with the responsibility of promoting the development of the American merchant marine. It also supervises the activities of the Merchant Fleet Corporation, its subsidiary. In general, the United States Shipping Board Bureau performs the duties formerly delegated to the United States Shipping Board—including the regulation of shipping, the administration of the Construction Loan Fund, the handling of various financial matters involving obligations of shipping companies to the Government, etc.

The Merchant Fleet Corporation, now operated by the Shipping Board Bureau, is a corporation organized under the laws of the District of Columbia. Its stock is entirely owned by the Federal Government with the exception of the qualifying shares held by a board of seven trustees, all of whom are Government employees. The Fleet Corporation is capitalized at $50,000,000, divided into shares of $100 par value each. Although originally authorized by Congress to expedite the purchase, construction, equipment, lease, charter, maintenance, and operation of merchant vessels in the commerce of the United States, it is now in process of liquidation, and it is anticipated that its functions will be reduced to a minimum when its principal remaining assets in the form of vessels and equipment can be properly disposed of.

Meanwhile, the Merchant Fleet Corporation has the care of the reserve fleet of 286 vessels (the remnant of the great Government war-time fleet), and supervises the operation of 46 of them, which are being operated under contract by four private companies. Six marine terminals, built by the War Department to meet emergency needs, are controlled by the Fleet Corporation and leased by it to private operators, in the interests of the various ports at which they are located and of the Government. The Corporation has custody of certain real estate and supplies, engages in marine-insurance underwriting, and performs various financial and legal work incidental to the administration of these enterprises.

The Shipping Board Bureau is in charge of a Director; the Merchant Fleet Corporation is headed by a President, who is assisted by Vice Presidents and the above-mentioned board of trustees.

DIVISIONS OF THE SHIPPING BOARD BUREAU

The Division of Shipping Research keeps accurate records of all vessel movements and water-borne commerce to and from the United States as well as in the domestic intercoastal trade. These records include passenger movements by classes, and cargo movements by commodities and volume.

This Division carries on extensive research to determine the status of the world's merchant marines, furnishing particulars of all vessels of 1,000 gross tons and upward, as to flag, tonnage, age, speed, draft, form of propulsion, and principal dimensions. It also conducts a study of ocean trade routes, and operating-cost differentials between American and foreign vessels.

The Division of Loans and Sales investigates applications for loans under the Construction Loan Fund, examines plans and specifications and all particulars of each project in cooperation with the Navy Department, and makes recommendations relative thereto. It investigates proposals for purchase of ships owned by the Government and submits appropriate recommendations, appraising the value of ships held for sale, determining their depreciation, and, in cooperation with the Navy Department, classifying the ships as to their possible usefulness as naval auxiliaries.

The Division has also undertaken a study of suitable designs of vessels for additions to the American merchant marine, in connection with which it is cooperating with the American Marine Standards Committee in furthering the promulgation of marine standards. It is charged with the determination of shipbuilding cost differentials between American shipyards and those in foreign maritime countries.

The Division of Traffic deals with the revenue-producing part of our commercial shipping. In special cases, in connection with foreign trade only, the Division assists in the establishment of passenger and freight-rate schedules, trade routes, and sailing schedules. It contacts American shippers, merchants, and trade organizations concerning the establishment of commercial practices and policies for the Merchant Fleet Corporation as a common carrier of cargo and passengers, including contract terms and conditions of carriage expressed in shippers' and steamship owners' agreements, contracts of affreightment, bills of lading, etc.

This Division also participates in the negotiation of commercial trade agreements, surveys the activities of competitive lines and the consummation of conferences, pooling, rate-making, and joint sailing agreements. It supervises these functions over the lines operated for the account of the Government and acts in an advisory capacity with privately owned lines for the purpose of maintaining harmony among them, assisting all American-flag lines in their negotiations with competitive foreign lines, and stabilizing at the same time conditions of rates and carriage in world trade.

The Division of Regulation administers all regulatory provisions of the Shipping Act of 1916, and acts amendatory and supplementary thereto, as well as the Intercoastal Act of 1933. Its work in relation to steamship companies in foreign and domestic commerce corresponds generally to that of the Interstate Commerce Commission in relation to railroads, but no jurisdiction over inland waterway carriers is exercised except where they operate in through movements with carriers on the high seas or the Great Lakes.

Under the power given the Secretary of Commerce to suspend rate changes pending an investigation of their lawfulness, the Division of Regulation hears complaints from shippers, private steamship owners, civic bodies, and others against alleged unreasonably high rates and discriminatory practices. The Secretary has the power to order such rates and practices changed. Through the Division the Secretary approves or disapproves the fixing of rates, the pooling of earnings, and allotting of traffic and ports by private steamship owners'

conferences. He also approves or disapproves transshipment rates and the division of revenue from such transshipment services between participating carriers. In the intercoastal trade, rate changes can be suspended for periods of four months pending investigations as to their lawfulness.

DIVISIONS OF THE MERCHANT FLEET CORPORATION

The Division of Operations has custody of and is directly in charge of all physical properties of the Merchant Fleet Corportaion and functions in the general administration of ship-operating matters. It negotiates operating agreements and charters and supervises the operation and maintenance of all the active vessels of the Corporation. It is responsible for the administration, safety, and preservation of all the "reserve" or laid-up ships.

The Division has control of the terminal and real-estate properties of the Corporation, supervising their operation and maintenance. It administers the Merchant Fleet Corporation's stock of vessel equipment, including maintenance of warehouses, purchases of supplies, sales of surplus material and inventories. It supervises the employment of licensed personnel on owned and chartered vessels.

The Division of Insurance handles all insurance matters for the Merchant Fleet Corporation and assists and advises other divisions of the Shipping Board on insurance questions. It examines all policies arranged by mortgagors, lessors, and contractors to see that they conform to the terms of the various agreements, and it administers the General Insurance Fund created on July 31, 1928, under authority of the Merchant Marine Act, 1928. The Division also officiates, in conjunction with the legal staff, on all claims arising under "protection and indemnity insurance" prior to July 1, 1929. It handles various general questions with the American marine-insurance market, and obtains information from steamship owners and underwriters for the purpose of preparing periodical reports on the condition of the marine-insurance market in the United States.

In addition to the foregoing divisions there are the office of the treasurer, the secretary, the general comptroller, and the legal staff, which function as do similar offices in any commercial organization.

THE SHIPPING BOARD PROGRAM

The duties and responsibilities of the Shipping Board Bureau can be generally divided into two groups: First, administering the affairs of the Merchant Fleet Corporation in a manner similar to that of the former Shipping Board; and, second, conducting the more important and permanent work of promoting the development of the American merchant marine, and regulating the rates and practices of privately owned steamship companies of all flags operating to or from our ports. The former activity can be regarded as essentially temporary in character, while the latter must be considered as a long-range program of the greatest possible importance.

Involved in this program are the formulation of a sound policy of shipping regulation with a view to bringing about greater stability in the shipping industry; the performance of the necessary research work incidental to the development of trade routes, the ascertainment of facts regarding American and foreign vessel construction and operating costs, cargo and passenger movements, and similar data; the judicious lending of Government funds for the construction of vessels which are required to replace the considerable number of vessels in the American merchant marine which are becoming obsolete; the protection of the Government's financial interest in the shipping industry; and the development of other broad policies which will be conducive to the sound growth of an adequate American merchant marine.

It may well be said that ships bearing the American flag are floating parts of the United States sailing the seven seas. They are not only part of a great commercial enterprise, but can be messengers of good will bearing our citizens and our merchandise and our friendly greetings throughout the world. The Shipping Board Bureau is engaged in furthering the welfare of the merchant marine constituted by those ships, in stimulating its progress, and in aiding it to regain he outstanding place it held in the days of the clipper ships.

NATIONAL BUREAU OF STANDARDS

LYMAN J. BRIGGS, Director

In a vault at the National Bureau of Standards two pieces of platinum-iridium alloy are preserved with great care because they constitute the basis of the whole system of weights and measures used in the United States. One is the standard of length, the standard meter; the other, the standard of mass, the standard kilogram. The meter and kilogram are not mere inert objects deposited at the Bureau for safe-keeping—they actively function as perhaps the most important of all controls in the complex processes we call industry, for it is the primary duty of the Bureau to maintain for every industry derived standards based on the national standards.

The setting up and maintenance of derived standards is just as exacting as the establishment of the basic standards. The Bureau must even anticipate the need for new types and kinds of standards, and, therefore, it conducts researches in all the fields of standardization and measurement so as to keep ahead or abreast of the increasingly complex measures of industry, as to range, accuracy, or variety. A few years ago who would have dreamed of the necessity of a standard of radio frequency good to one part in five million? The broadcasting of such a standard is now a routine function of the Bureau.

HISTORY

The Constitution gave Congress power "to fix the standard of weights and measures," and the work of the Bureau was founded upon that brief clause. After adopting the Constitution, however, progress was slow, although it was well known that weights and measures throughout the country were far from uniform. Not until 1830 was a small Office of Standard Weights and Measures set up in the Coast Survey, then under the Treasury Department. The occasional comparison of State and manufacturers' standards with the national standards of length and mass constituted the entire work of the Office. Work on derived standards, now so essential to industry had little or no place in its activities.

Standardization activities abroad were stimulated by the establishment, in 1875, of the International Bureau of Weights and Measures. Some years later Germany and Great Britain established national standardizing laboratories. In some cases American manufacturers were sending their instruments abroad for certification. Stimulated by the growth of standardizing laboratories abroad, and in response to the growing demand for a similar governmental laboratory in this country, Congress by act approved March 3, 1901, enacted that "The

Office of Standard Weights and Measures shall hereafter be known as the National Bureau of Standards."

The new Bureau was given functions consistent with the modern, broad view of standards and of the need for research and testing in applying them. In 1903 the Bureau moved to a beautiful site, now comprising 56 acres in the residential suburbs of Washington. Its specially designed buildings house some of the finest existing equipment, and its field stations provide facilities for work which cannot well be carried on in Washington.

FUNCTIONS

The Bureau's functions are, briefly: The development, construction, custody, and maintenance of the reference and working standards used in science, engineering, industry, and commerce; their intercomparison; research connected with standards; and the determination of physical constants and the properties of materials.

Under the organic act, the Bureau exercises these functions "for the Government of the United States; for any State or municipal government within the United States; or for any scientific society, educational institution, firm, corporation, or individual within the United States engaged in manufacturing or other pursuits requiring the use of standards or standard measuring instruments"—showing the broad intent of Congress as to the Bureau's services.

Bureau researches begin with requests from the Government or from scientific and technical organizations and are often conducted with their cooperation. The object is usually to develop better standards of measurement, quality, performance, or practice. The "research-associate plan" furthers this cooperation. An industrial or technical group may send to the Bureau technical research workers under Bureau supervision on problems of mutual interest to industry and the Government. The results, which have covered a wide range of subjects from dental materials to automobile fuels, become public property and are published either by the Bureau or in the technical press.

The Bureau is the principal laboratory for testing supplies purchased for Government use, and it also conducts tests for the public. In the latter the Bureau avoids competing with private laboratories; its tests are such as cannot well be made elsewhere.

The Bureau's staff of 650 members is divided into 2 branches: one for scientific and technical research and testing; the other for commercial standardization. Under research and testing are 9 divisions, while 4 divisions form the commercial standardization branch.

ACTIVITIES OF RESEARCH AND TESTING BRANCH

The Weights and Measures Division is custodian of the national standards of length and mass and is concerned with the comparison of working standards with these reference standards. The Bureau designs, constructs, or improves apparatus for making measurements of length, mass, pressure, and many

other quantities. It conducts researches to define or measure more accurately the value of certain "physical constants."

The Division had much to do with a nation-wide campaign for more efficient local weights-and-measures inspection services and for correct measures in daily trade. It has published a handbook for sealers and initiated a series of annual conferences on weights and measures.

This Division devised a new technique for making and testing gage blocks of very high precision and undertook the testing of railroad track scales in 1913.

Using One of the High-Precision Balances in the Mass Section of the Weights and Measures Division.

A gold plated bronze weight (left) is being compared with one of the platinum-iridium standards (right). This balance is used mostly for kilogram weights and the error in comparing such weights is only 1 part in 100 million. The balance is controlled through long rods, so that the heat of the observer's body will not disturb the air in the balance case.

At that time, for 10 scales inspected only 3 were correct within the prescribed tolerance, whereas today over 8 in 10 scales inspected are found correct.

The Electricity Division conducts researches on such problems as the values of the absolute electrical units, methods of measuring the electrical quantities, and the electrical and magnetic properties of various substances. Electrical instruments and apparatus, batteries, and transformers are tested and their design and construction are improved.

The Bureau has developed a new standard of light which makes use of radiation from a hollow cavity immersed in molten platinum at its "freezing" point (3,200° F.), the light quantity and quality of which are constant. This is now being proposed for adoption as a world standard of light.

The Bureau has made important contributions to radio—the radio direction finder, the radiobeacon, plane-to-ground two-way telephone system, and the blind landing system. This Division also maintains the fundamental standard of radio frequency and broadcasts standard frequency signals accurate to within 1 part in 5 million.

Large savings have resulted from the Bureau's experiments and surveys of the damage resulting from electrolysis of underground structures and of the corrosion of buried pipe lines as well as from its electrical and other safety codes which have been prepared as guides to industry and to States and municipalities in preventing accidents.

The Division of Heat and Power aided in establishing the present international standard scale of temperature. It developed the electrical resistance thermometer, and introduced the pyrometer for high-temperature measurements in the steel industry, particularly in the rolling of railroad rails. By making possible the accurate control of temperature in the finishing operations certain defects in rails were largely eliminated and accidents reduced.

The Division maintains a plant for liquefying air, hydrogen, and helium, an important factor in the discovery of heavy hydrogen and heavy water. On request of the refrigeration engineers the Bureau determined the thermodynamic properties of ammonia and other basic data on the materials used in refrigeration, thus helping to bring about the present advanced state of this art.

Data on the causes and effects of fires, gained from experimental conflagrations, have served as the basis for building codes and have quickly entered into building practice.

Cooperative investigations are conducted on internal-combustion engines, fuels, and lubricants. The Division maintains an altitude laboratory—the first ever constructed—for studying aircraft engine performance under actual flight conditions and in which the low air pressures and temperatures encountered at altitudes up to 30,000 feet can be duplicated.

The Division of Optics is concerned with the varied uses of light and its properties, particularly its measurement and control. The wave lengths of the characteristic radiation from chemical elements, as disclosed in their spectra, are determined with an accuracy of 1 part in 10,000,000. Many of these wave lengths are now serving as international standards, especially for the study of the stars and the sun.

Wave lengths of light have been applied to the production of standards of length of unequalled accuracy; certain linear scales ruled from light waves were found to have no measurable error and could be used without correction factors. This means a continuous saving in the plants in which these scales are employed

Both visible and invisible radiation are measured, and more than 2,000 color glasses used in the grading of oils and other products have been standardized. The American Railway Association has made the Bureau the custodian of the national standards for the color of railway signal glasses.

The Bureau checks the optical equipment and measurements of the laboratories of the Customs Service which determine the duty to be paid on imported sugar at the ports of entry. The International Commission for establishing uniform methods of sugar analysis has adopted the Bureau's scale for regulating the buying and selling of sugar throughout the world.

The Division of Chemistry conducts fundamental investigations in which chemical methods are principally employed, tests materials used by the Government, aids in drafting specifications for chemical properties of such materials, and devises instruments and methods for chemical testing. Its standardization of the purity of chemical reagents and distribution of standard samples have advanced the accuracy of commercial chemical analyses and have, therefore, aided in the manufacture of more uniform and reliable products.

The first practical method of producing electroplated coatings of chromium was developed in the Bureau's experimental plant.

Recently completed researches have resulted in better methods for separating the metals of the platinum group, and the separation of the constituents of petroleum—a cooperative project with the American Petroleum Institute—is resulting in dependable control data for the petroleum industry.

The joint research which resulted in the discovery of "heavy hydrogen" and "heavy water" opens up a new and important subject for chemical research, and is already claiming the attention of many laboratories throughout the world. Pure transparent rubber has been produced, and a procedure for crystallizing pure rubber has been devised and applied.

Gas problems, particularly as affecting safety, are studied, and publications on gas service have been issued. Dangerous attachments, supposed to save gas, but which in reality constitute serious hazards, have been largely eliminated as a result of the Bureau's work.

The Division of Mechanics and Sound is engaged in research and testing in the fields of mechanics, engineering, aircraft instruments, aerodynamics, hydraulics, sound, and the properties of fabricated structures and members. The sound transmission of building panels has been measured, as well as the sound absorption of special materials designed to correct acoustical defects. Dependable data derived by the Bureau on new acoustical materials are a factor in stimulating progress in the newly important industries of manufacturing those materials and in the engineering of quiet in buildings.

In the national hydraulic laboratory the flow in plumbing systems of high buildings, the behavior of deep-well current meters, loss of head at pipe bends, and the effect of silt-laden water in scouring a sandy river bed are being studied. A tank 400 feet long is used for testing meters which gage the flow of streams to predict water supply, flood, and drought.

Three wind tunnels are provided for solving problems in aerodynamics. An example is the determination of the wind pressures around and upon a model of the Empire State Building. Some work has been done on the wind resistance of automobile bodies and the parts of aircraft, especially to improve the stream-lining.

Aircraft instruments are studied and tested, and improved when possible, so as to give the pilot more accurate data on flight conditions. Bridge columns, beams, girders, and other fabricated structural members are tested, and their

behavior under loads up to 10,000,000 pounds are observed. Important tests in connection with the Philadelphia-Camden bridge, a leading hotel in Chicago, and the George Washington Bridge in New York were made in the largest of the Bureau's testing machines.

The Division of Organic and Fibrous Materials tests and investigates paper, textiles, rubber, and leather to determine their basic properties, and their fitness for Government use. For instance, research in the experimental paper mill has increased by more than 50 percent the life of the Government's currency paper. The data were also found applicable in the commercial production of high-grade bond and ledger papers, adding to their useful life without increasing the cost.

Model of Empire State Building in 10-Foot Wind Tunnel.

This view illustrates the method followed by the Bureau in making wind pressure measurements on a model structure. In this particular case the model is constructed to a scale of 1:250 and is provided with pressure gage connections at various floor levels. Pressures are determined with the model in various positions and at different wind velocities up to 60 miles an hour.

The high acidity of the air in cities was found to result in serious damage to books and papers in libraries. Means for overcoming this have been developed and were applied in the Folger Shakespeare Library in Washington.

The useful properties of fabric have been correlated with variations in the nature of the weave. Machines for measuring the wearing quality of such diverse products as silk hosiery and of carpets have been constructed and adopted as standard testing devices.

Research on the effects of tanning materials and fillers was completed for the leather industry, and the relative utility of leather from every part of a hide for making shoe soles was measured and the results published.

The farm waste work of this Division has resulted in many new processes for utilizing cornstalks, oat hulls, straw, and other materials.

The Division of Metallurgy studies metals and alloys to ascertain their structure and behavior under service conditions. It is equipped to prepare metals and

alloys of any desired composition or purity, and to make macroscopic and microscopic studies of them. Different methods of annealing, tempering, casting, and welding are studied, and the results used to improve metallurgical processes. For example, duralumin is now safeguarded by coating it with aluminum as advised and first accomplished by the chief of this Division.

The machinability of metals and their wear resistance have been determined and their crystal structure studied. The properties of molding sands from many sources have been ascertained and means of measuring them devised.

The Clay and Silicate Products Division is devoted to the experimental studies of clay, stone, cement, and other structural materials. Unusual problems are sometimes presented. For example, very large structures, such as Boulder Dam, call for less heat evolution when concrete hardens. Facilities are now provided for measuring this heat of hydration. In a brief period this property, formerly of little interest, has become of paramount importance. Studies of methods of pre-treating, heat treating, and blending clays resulted in the development of processes by which American materials can be used for purposes for which formerly imported clays were considered essential. A cement reference testing laboratory is maintained jointly by the Bureau and the American Society for Testing Materials. If a given laboratory is inspected and found well equipped and manned, it is certified as qualified for testing purposes.

Prior to the World War no optical glass was produced in America. The Bureau's work helped to develop the needed technique, the highest grades of glass are now regularly supplied to the Navy, and the nucleus exists for a national optical-glass industry in this country.

ACTIVITIES OF THE COMMERCIAL STANDARDIZATION BRANCH

The Division of Simplified Practice cooperates with industrial and commercial groups in reducing waste, through eliminating needless varieties of product, method, or practice. Its function is to bring together all parties interested in a project of this character, and to coordinate their work in developing a simplified practice recommendation. The Division stands ready to render service in developing and making effective any application of simplified practice which wil reduce waste, stabilize business, or extend commerce.

The Building and Housing Division cooperates with business, technical, and professional groups in furthering construction activities. It works to modernize building codes and to encourage improved standards for the quality of building construction, and the practical application of the latest developments in design and use of building materials.

The Division of Specifications promotes and facilitates the use and unification of specifications. It cooperates with technical societies; trade associations; Federal, State, and municipal government agencies concerned with making and using specifications; producers, distributors, and consumers; and testing and research laboratories. Lists are compiled of sources of supply of materials guaranteed to comply with nationally recognized standards and specifications, and both buyers and sellers are shown the benefits to be gained from handling nationally specified, certified, and labeled commodities. The Division prepares

directories of governmental and nongovernmental testing laboratories and the Directory of Specifications.

The Division of Trade Standards, on request, assists industrial and commercial groups in the voluntary establishment of standards covering grades, quality, dimensional interchangeability, or other acceptance criteria as a national basis for marketing manufactured commodities.

The detail criteria are selected or determined voluntarily by interested buyers or sellers, and adjusted at a general conference of producers, distributors, and users so as to represent the composite views of all branches. The Division functions chiefly as a neutral agency to see that all interested elements are given full opportunity to be heard and to be satisfied; to solicit and record acceptances; and to publish and promulgate the standard when a satisfactory majority of acceptances is obtained, and provided there is no active opposition.

Industries are encouraged to apply self-certifying labels to products meeting the commercial standard requirements, as a means of protecting the consumer and the scrupulous seller from misrepresentation or unfair methods of marketing.

MAKING THE RESULTS AVAILABLE

The scientific and technical results of the Bureau's work are made available through personal interviews, correspondence, national committee work, by printed publications in the several series issued by the Bureau, and in the technical press. The letters answered cover diverse subjects in almost every field of science and technology. Many visitors come for advice on difficult problems. All results of original research are published either in a recognized outside journal or in the Journal of Research of the National Bureau of Standards. A file of the monthly Journal, available by subscription, is a unique record of scientific achievements. Reprints of the individual reports in the Journal are later made available as separate Research Papers.

The Technical News Bulletin is a monthly publication containing abstracts of all papers in the Journal of Research. It gives a current picture of work in progress in the laboratories, and lists all papers by members of the Bureau's staff both in its own series and in outside journals.

Circulars contain compiled information not necessarily the result of original research. Recommended safety codes are prepared as convenient pocket-size handbooks. Miscellaneous Publications comprise charts, data, and other material not well adapted to another series. The nature of Simplified Practice Recommendations, Commercial Standards, the Directory of Specifications, and the Building and Housing publications is self-evident. In addition, many mimeographed Letter Circulars have been issued containing current information on subjects of general interest.

A complete list of Bureau publications (Circular no. 24 and supplement) with index and abstracts is available by purchase from the Superintendent of Documents, Government Printing Office, Washington, D.C. The Bureau's papers are also available for reference purposes at the principal Government depository libraries of the country, and in most of the libraries of scientific and technical colleges and societies.

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